

FORTIETH ANNUAL REPORT  
OF THE  
NORTH CAROLINA  
**Agricultural Experiment Station**

CONDUCTED JOINTLY BY THE

N. C. DEPARTMENT OF AGRICULTURE

AND THE

N. C. STATE COLLEGE OF AGRICULTURE AND ENGINEERING

FOR THE

YEAR ENDED JUNE 30, 1917

INCLUDING

Bulletin No. 237, and Technical Bulletins 11, 12 and 13



## LETTER OF SUBMITTAL

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RALEIGH, N. C., June 30, 1917.

*To His Excellency, T. W. BICKETT,  
Governor of North Carolina.*

SIR:—I have the honor to submit herewith report of the operations of the Agricultural Experiment Station, conducted jointly by the North Carolina Department of Agriculture and the North Carolina State College of Agriculture and Engineering, for the year ended June 30, 1917. This work is under the immediate direction of the "Joint Committee for Agricultural Work," provided for in chapter 68 of the Public Laws of 1913, and amended by chapter 223 of the Public Laws of 1917, and the report is made in accordance with the requirements of the Act of Congress approved March 2, 1887, and known as the Hatch Act.

Very respectfully,

B. W. KILGORE,  
*Director.*

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### BULLETINS:

No. 237—Tobacco Culture in North Carolina.

### TECHNICAL BULLETINS:

No. 11—Self-sterility in Dewberries and Blackberries.

No. 12—Inheritance of Sex in *Vitis Rotundifolia*.

No. 13—Biological Investigation of *Sphenophorus Callosus* Oliv.

## BOARD OF AGRICULTURE

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| *R. L. WOODARD..... | Pamlico   | WILLIAM BLEDSOE.....                     | Gale          |
| *CLARENCE POE.....  | Raleigh   | H. Q. ALEXANDER.....                     | Matthews      |
| R. W. SCOTT.....    | Haw River | A. CANNON.....                           | Horseshoe     |

## BOARD OF TRUSTEES OF THE COLLEGE

|                       |                |                                                  |             |
|-----------------------|----------------|--------------------------------------------------|-------------|
|                       |                | *GOVERNOR T. W. BICKETT, <i>Chairman</i>         |             |
| M. B. STICKLEY.....   | Concord        | *T. T. THORNE.....                               | Rocky Mount |
| T. T. BALLINGER.....  | Tryon          | *C. W. GOLD.....                                 | Greensboro  |
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| *O. L. CLARK.....     | Clarkton       | P. S. BOYD.....                                  | Mooresville |
| EVERETT THOMPSON..... | Elizabeth City | W. E. DANIEL.....                                | Weldon      |
| R. H. RICKS.....      | Rocky Mount    | *W. H. RAGAN.....                                | High Point  |
| W. R. BONSALE.....    | Hamlet         | W. B. COOPER.....                                | Wilmington  |
| D. R. NOLAND.....     | Crabtree       | A. M. DIXON.....                                 | Gastonia    |
|                       |                | *W. C. RIDDICK (President College), West Raleigh |             |

## STAFF OF THE AGRICULTURAL EXPERIMENT STATION AND EXTENSION SERVICE

### Administration

|                            |                                                      |
|----------------------------|------------------------------------------------------|
| B. W. KILGORE.....         | Director of Experiment Station and Extension Service |
| C. B. WILLIAMS.....        | Vice Director, Experiment Station                    |
| R. W. COLLETT.....         | Assistant Director, Branch Stations                  |
| S. G. RUBINOW.....         | Assistant to Director                                |
| F. H. JETER.....           | Agricultural Editor                                  |
| A. F. BOWEN.....           | Bursar                                               |
| Miss S. D. JONES.....      | Bursar                                               |
| Miss MARY S. BIRDSONG..... | Secretary to Director                                |

### Agronomy

|                             |                            |                                |                          |
|-----------------------------|----------------------------|--------------------------------|--------------------------|
| C. B. WILLIAMS.....         | Chief in Agronomy          | 2R. B. HARDISON..              | Assistant in Soil Survey |
| J. K. PLUMMER.....          | Soil Chemist               | S. O. PERKINS...               | Assistant in Soil Survey |
| W. F. PATE.....             | Agronomist-Soils           | L. L. BRINKLEY..               | Assistant in Soil Survey |
| E. C. BLAIR.....            | Assistant Agronomist-Soils | 2E. S. VANETTA..               | Assistant in Soil Survey |
| J. O. WARE.....             | Assistant Agronomist-Soils | S. F. DAVIDSON..               | Assistant in Soil Survey |
| R. Y. WINTERS.....          | Plant Breeding             | 1E. H. MATTHEWSON.....         | Tobacco Expert           |
| C. C. LOGAN.....            | Extension Agronomist       | A. R. RUSSELL,                 |                          |
| W. R. HERMAN,               |                            | Assistant in Field Experiments |                          |
| Assistant in Plant Breeding |                            |                                |                          |

### Chemistry

|                    |                    |                       |                   |
|--------------------|--------------------|-----------------------|-------------------|
| W. A. WITHERS..... | Chemist            | J. Q. JACKSON.....    | Assistant Chemist |
| F. E. CARRUTH..... | Assistant Chemist  | E. S. DEWAR.....      | Assistant Chemist |
| J. M. PICKELL..... | Feed Chemist       | T. M. HILL.....       | Assistant Chemist |
| W. G. HAYWOOD..... | Fertilizer Chemist | B. T. HORSFIELD ..... | Assistant Chemist |

### Entomology

|                        |                     |                   |                        |
|------------------------|---------------------|-------------------|------------------------|
| FRANKLIN SHERMAN, JR., | Chief in Entomology | R. W. LEIBY.....  | Assistant Entomologist |
| Z. P. METCALF.....     | Entomologist        | J. E. ECKERT..... | Assistant Entomologist |
|                        |                     | C. L. SAMS.....   | Bee-keeping            |

### Horticulture

|                      |                          |                                    |                          |
|----------------------|--------------------------|------------------------------------|--------------------------|
| W. N. HUTT.....      | Chief in Horticulture    | J. P. GRIFFITH....                 | Assistant Horticulturist |
| J. P. PILLSBURY..... | Horticulturist           | R. H. G. HILL.....                 | Assistant Horticulturist |
| L. R. DETJEN.....    | Assistant Horticulturist | B. SZYMONIAK,                      |                          |
| C. D. MATTHEWS..     | Assistant Horticulturist | Exten. Work—Hortil. and Entomology |                          |

### Animal Industry

|                    |                                      |
|--------------------|--------------------------------------|
| DAN T. GRAY.....   | Chief in Animal Industry             |
| R. S. CURTIS.....  | Associate in Animal Industry         |
| W. H. EATON.....   | Dairy Experimenter                   |
| B. F. KAUPP.....   | Poultry Investigator and Pathologist |
| SA. J. REED.....   | Dairy Farming                        |
| SJ. E. MOSES.....  | Pig Club Agent                       |
| SA. G. OLIVER..... | Poultry Club Agent                   |



|                      |                                          |
|----------------------|------------------------------------------|
| STANLEY COMBES.....  | Assistant in Dairy Farming               |
| 3J. A. AREY.....     | Assistant in Dairy Farming               |
| 3F. R. FARNHAM.....  | Assistant in Dairy Farming (Cheese Work) |
| 3R. H. MASON.....    | Assistant in Dairy Farming               |
| 3D. R. NOLAND.....   | Assistant in Dairy Farming (Cheese Work) |
| 3F. T. PEDEN.....    | Assistant in Beef Cattle                 |
| 3A. L. JERDEN.....   | Assistant in Beef Cattle                 |
| 3L. I. CASE.....     | Assistant in Beef Cattle                 |
| EARL HOSTETTLER..... | Assistant in Beef Cattle and Swine       |
| DAN M. MCCARTY.....  | Assistant in Animal Nutrition            |
| J. E. IVEY.....      | Assistant in Poultry Investigation       |

### Plant Pathology

|                     |                          |                     |                             |
|---------------------|--------------------------|---------------------|-----------------------------|
| F. A. WOLF.....     | Plant Pathologist        | E. E. STANFORD..... | Assistant in Bacteriology   |
| R. O. CROMWELL..... | Assistant—Plant Diseases | A. C. FOSTER.....   | Assistant in Plant Diseases |

### Drainage

|                   |                          |                  |                             |
|-------------------|--------------------------|------------------|-----------------------------|
| 4H. M. LYNDE..... | Senior Drainage Engineer | F. R. BAKER..... | Assistant Drainage Engineer |
|-------------------|--------------------------|------------------|-----------------------------|

### Veterinary

|                    |                        |
|--------------------|------------------------|
| G. A. ROBERTS..... | Veterinarian           |
| J. I. HANDLEY..... | Assistant Veterinarian |

### Markets and Rural Organization

|                        |                                              |
|------------------------|----------------------------------------------|
| W. R. CAMP.....        | Chief, Division of Markets                   |
| O. J. MCCONNELL.....   | Assistant in Cotton Grading and Marketing    |
| J. A. LIVINGSTONE..... | Assistant Superintendent of Credit Unions    |
| BOLLING HILL.....      | Assistant in Marketing Fruits and Vegetables |

### Farm Management

|                     |                 |
|---------------------|-----------------|
| 5J. M. JOHNSON..... | Farm Management |
|---------------------|-----------------|

### Branch Stations

|                    |                                                          |
|--------------------|----------------------------------------------------------|
| R. W. COLLETT..... | Assistant Director, in Charge Branch Stations            |
| F. T. MEACHAM..... | Assistant Director Iredell Branch Station, Statesville   |
| R. G. HILL.....    | Assistant Director Pender Branch Station, Willard        |
| C. E. CLARK.....   | Assistant Director Edgecombe Branch Station, Rocky Mount |
| E. G. MOSS.....    | Assistant Director Granville Branch Station, Oxford      |
| S. C. CLAPP.....   | Assistant Director Buncombe Branch Station, Swannanoa    |
| H. BOCKER.....     | Assistant Director Black Land Branch Station, Wenona     |

### Farm Demonstration Work

|                     |                                       |
|---------------------|---------------------------------------|
| C. R. HUDSON.....   | State Agent                           |
| E. S. MILLSAPS..... | District Agent, Western District      |
| T. D. MCLEAN.....   | District Agent, Central District      |
| R. W. FREEMAN.....  | District Agent, Southeastern District |
| J. M. GRAY.....     | District Agent, Mountain District     |
| O. F. MCCRARY.....  | District Agent, Northeastern District |

### Boys' Agricultural Clubs

|                      |                                  |
|----------------------|----------------------------------|
| T. E. BROWNE.....    | State Agent and Rural Supervisor |
| A. K. ROBERTSON..... | Corn Club Agent                  |
| A. G. OLIVER.....    | Poultry Club Agent               |
| I. J. E. MOSES.....  | Pig Club Agent                   |
| W. KERR SCOTT.....   | Assistant Club Agent             |

### Home Demonstration Work

|                              |                                       |
|------------------------------|---------------------------------------|
| MRS. JANE S. MCKIMMON.....   | State Agent                           |
| MISS MINNIE L. JAMISON.....  | Assistant in Home Demonstration Work  |
| MISS LAURA M. WINGFIELD..... | District Agent, Central District      |
| MISS LIZZIE J. RODDICK.....  | District Agent, Eastern District      |
| MRS. J. H. HENLEY.....       | District Agent, Unorganized Territory |

The members marked with \* are members of the Joint Committee for Agricultural Work, and the Experiment Station and Extension Service are under their direction.

1In cooperation with the U. S. Department of Agriculture, Bureau of Plant Industry.

2In cooperation with the U. S. Department of Agriculture, Bureau of Soils.

3In cooperation with the U. S. Department of Agriculture, Bureau of Animal Industry.

4In cooperation with the U. S. Department of Agriculture, Office of Public Roads and Rural Engineering.

5In cooperation with the U. S. Department of Agriculture, Office of Farm Management.

6In cooperation with the U. S. Department of Agriculture, Bureau of Entomology.

FORTIETH ANNUAL REPORT  
OF THE  
**North Carolina Agricultural Experiment Station**

For the Year Ending June 30, 1917

B. W. KILGORE, *Director.*  
F. H. JETER, *Agricultural Editor.*

This report covers the activities of the Agricultural Experiment Station, conducted jointly by the North Carolina Department of Agriculture, the North Carolina State College of Agriculture and Engineering, and in coöperation with the United States Department of Agriculture, for the year beginning July 1, 1916, and ending June 30, 1917.

Much progress has been made on all the projects or studies which are being conducted by the Station and much additional original information has been secured as a result of the experimental inquiries. The workers in the various divisions have been faithful and efficient in the discharge of their duties and have endeavored to advance in every way possible the cause of improved agriculture for the entire State.

Working through the staff of the Extension Service, the information which has been obtained has been disseminated over the State and has been reflected in a substantial betterment of improved farming conditions. The Experiment Station is entering more and more into the life of the farming public and is more and more being called upon for leadership in solving those problems peculiar to North Carolina.

A number of changes in staff have occurred. Most of these have been due to the patriotism of assistants who have felt the call of their country and have left to serve in other ways than those offered by work of agricultural investigation. The men who have severed their connection with the staff have accepted service in the National Department of Agriculture or have volunteered for service in some branch of the Nation's fighting forces. These have been:

- L. I. Case, in service.
- T. M. Hill, in service.
- A. L. Jerdan, in service.
- H. D. Lambert, in service.
- J. R. Mullen, in service.
- F. C. Wiggins, in service.
- E. E. Culbreth, commercial work, North Carolina.
- S. C. Clapp, transferred to Branch Experiment Station, Buncombe County, N. C.
- B. P. Folk, farming.
- E. B. Hart, Southland Cotton Oil Co., Paris, Texas.
- R. G. Hill, U. S. Department of Agriculture.
- J. H. Jefferies, farming.
- F. N. McDowell, transferred to County Agent, North Carolina.
- G. H. Rea, Department of Agriculture, Pennsylvania.
- E. E. Stanford, Bureau of Chemistry, U. S. D. A.

The Station has pursued a line of policy in conformity with that of previous years, that is of attempting to keep somewhat in advance of the demands which are actually made upon it for information. Since the entering of this country into hostilities, however, efforts have been made to put the investigational work on a war footing, studying problems relating principally to the abnormal conditions occasioned by our entry into the world conflict. These efforts have taken the form of increased production of food and feedstuffs as they relate to soil fertility, crop rotations, fertilizing problems, the control of insects and plant and animal diseases, the maximum production and conservation of meats and the study of problems connected with organizing and saving. All of these and others have been given special consideration; and, in addition to this, many facts gathered by previous experimental work have been given to the people of the State through the Extension workers, through the different publications of the Station, through the press of the State and through magazines of local and national importance.

It is timely, also, at this point to mention the fact that the best of coöperation has been given the Station by the State press, by the coöperative institutions and by various commercial and industrial organizations. The program of work to which the Station committed itself at the beginning of the war has been published in every leading paper of the State and later the findings of experiments have been as willingly published and circulated. One paper issued a special edition during the year in which the work was outlined by the heads of the different divisions, and was published in its entirety.

The Station workers, forty-eight in number, have been prominent at meetings originated by the Extension Service or other organizations and individuals, and have given the results of carefully planned and conducted experiments in such a manner as to lend weight and authority and to give help to present agricultural needs. The farmers of the State are doing their part heroically in the production of food and feedstuffs for the supply of a hungry world. They have called upon the Station more during the past year than at any previous time in the history of the State, and through the Extension Service, with which the Station is closely allied, they have been served as efficiently as possible.

The different divisions have worked out much authoritative data on many of the different questions concerning farming and advanced agricultural operations and a resumé of this work may be found in the accompanying reports which are submitted. It will be seen that the program of these investigations is being developed to meet the needs of a constantly growing agriculture and to furnish helpful information in such places as it will be of most benefit.



## AGRONOMY.

The Division of Agronomy is making good progress under the four different lines of work to which it is devoting particular attention. These four lines are (1) the study of the soil characteristics of the soils of the State, which are being mapped in a systematic manner; (2) a study of the plant food requirements of the important soils; (3) crop rotation studies in which rational systems of rotations for the purpose of affording financial returns, as well as the gradual building up of the soils to a higher state of fertility is being worked out, and (4) crop improvement studies in which seed selection and breeding work enter largely.

Since the last report, surveys have been made and reports have been prepared for Cleveland, Beaufort and Stanly counties; and, Bertie and Orange counties have been more than half mapped. At the present time parties are at work in two other counties, Caldwell and Wilkes. This work is of vital importance to agriculture in North Carolina as it furnishes a definite and reliable basis for positive recommendations in regard to the handling of farm lands in counties where the surveys have been made and where experiments have been conducted on similar soil types elsewhere or in that same county.

In field experiments, the plant food deficiencies and needs of the soils of the State are being studied after the soil type has been determined. In addition to the plots on the central station farm and the branch station farms, this work is being done on seventeen different types of soil in private fields located in sixteen different counties; also eleven of the State farm-life schools have this work on their farms. Interesting phases of this same study are being developed in pot culture experiments, being made by the Soil Chemist.

In the improvements of crops, progress has been made to the extent that several of the Station farms are being stocked with high grade, pure bred seed, selected and improved by the Division. Corn, cotton, peanuts, soybeans, cow peas and the small grains, such as wheat, oats and rye, have all received a share of this work.

The systematic publication of county soil reports has been begun and reports of this character have been issued as State Department of Agriculture Bulletins for Mecklenburg, Gaston, Union and Cabarrus counties. These reports give definite information in regard to the agriculture, climate and soils of the counties.

## CHEMISTRY.

In addition to work with the nitrification and ammonification in soils in which the studies have been made largely with solutions, work in the Division of Chemistry has centered largely around the determination of the toxicity of cotton seed and its products. The Division has published five important articles in regard to the toxic principle of

cottonseed meal, kernels and other parts of the cotton plant, and has designated the toxic principle found in these as gossypol. Experiments have been made on various animals showing that this substance does cause the poisoning of swine and other animals and indicating that the explanations offered by other investigators that the injury is similar to beriberi and is caused by deficiency in diets, insufficient minerals or insufficient supplies of other soluble growth-promoting substance are not correct. It is also found that gossypol appears to be a constituent of the cotton plant only.

It has been found that the addition of iron in the form of ferrous sulphate and ferric chloride to cottonseed meal in feeding swine exerts a beneficial action. Wood ashes, however, do not seem to exercise to any extent beneficial effect in overcoming this toxicity of the meal.

#### ANIMAL INDUSTRY.

The investigational work of the Animal Industry Division is being conducted with swine, beef cattle, dairy cattle, sheep, horses and mules, and poultry. In the experiments with these animals, the main problems connected with their handling, production and feeding have been studied, except in the case of horses and mules, where insufficient funds made complete work with these inadvisable; however, all of the animals on the branch station farms are being fed cottonseed meal to replace corn in the daily ration, and the observations and records are being made. It has been found that the meal can replace a considerable amount of corn—feeding work stock.

Work with swine has centered largely around the use of pasturage for the cheaper production of pork. Soybeans, peanuts, and other crops have been used and the effect on the bodies of the animals has been carefully studied. It has been found that even where soft-bodied hogs are produced, these may be hardened by varying the rations before the animals are marketed. Two other problems concerning the cost of raising pigs to the weaning age, and the home curing of meat, have received considerable attention during the year and valuable information has been secured.

With beef cattle, the principal investigative projects have centered around the study of trembles, or milk sickness, and which, experiments indicate, is caused by a weed known as white snake root; and the feeding and wintering of steers on corn silage, peanut meal and various other rations in different parts of the State. The work being done on the farm of T. L. Gwyn, at Clyde, has probably exercised more influence in the State than any other, as here, there is a large supply of cattle available for studying the various methods of getting the steers through the winter months. Fine results have attended the work on this farm and the results have been given to the State from time to time.

Sheep work has been placed on a better basis during the past year

and investigations are now being conducted in Mitchell County, in addition to the central station farm and Iredell farm. This work centers largely around breeding of pure bred animals, eradication of the stomach worm and the winter feeding of ewes. The sheep is about the only animal which does not compete with man in the feed consumed, and in addition they furnish a quick means of increasing the meat supply, and for this reason the live stock workers are doing everything possible to encourage farmers to get more and better rams and breeding ewes. This request is being met with a favorable response.

In dairy cattle work a study of onion contamination of milk and the making of home cheeses has occupied the principal attention. Feeding problems, growing problems and other manufacturing problems are also being investigated. There has been a large growth in the mountain cheese industry.

The poultry work continues to be an important part of the investigational work of the Animal Industry Division. A large number of problems are, at present, being studied, and the utilization of grazing crops for poultry are being carefully investigated, as well as the building of hen houses, conserving of eggs and combating poultry diseases, which every year cause such enormous losses.

#### ENTOMOLOGY.

Investigational work in Entomology centers largely around the study of pecan insects, the corn-stalk borer, the spraying of potatoes and peaches, a survey of the insect life of the State, the study of the black corn weevil, the southern corn bill bug, the cow pea weevil, and the corn root worm. Good progress has been made along all lines of this work. The study of the pecan insects has proven especially valuable, as it is going along hand in hand with the development of the pecan industry of the State. Especial mention might be made of the injury by the pecan leaf case-bearer, which seriously injured many trees during the past year. Since the life history of this insect has been studied, satisfactory control was applied before much injury was done.

The study of the insect life of North Carolina is progressive favorably and many instructive facts have been placed on record in regard to the insects of the State. A study on the southern corn bill bug has been closed and the results published in Technical Bulletin No. 13. It is also found that cow peas may be treated by ordinary lime to prevent weevil injury, and a detailed report has been made of these results in the *Journal of Economic Entomology*. Investigations have indicated that the best date for sowing wheat in North Carolina is approximately October 15th. If sown earlier, it is liable to injury from the Hessian Fly.

Another project of interest has been that of bee-keeping work which was begun a year ago. At that time the bee-keepers were without organi-



ation, leadership, or official recognition; and at this time, under the leadership of a competent worker, much work is being done and the bee-keepers have been organized into a State Bee-keepers Association, which has its membership from over the entire State.

#### HORTICULTURE.

In Horticulture, the principal work of the year has been in the investigation of pecan varieties suitable for commercial purposes in North Carolina, the breeding of those varieties especially fitted to the State, the importation and testing of edible nuts, experiments with truck crops, including rotations, variety tests, different methods of cultivation and storage problems, especially with sweet potatoes at the Pender Trucking Branch Station.

Another feature of interest has been a study of what is known as Thermal Belts, in the western part of the State. This has been done in coöperation with the Weather Bureau. Considerable data also have been secured in the work with peaches on the various branch station farms and at Southern Pines. A bulletin was published covering this work as a State Department of Agriculture Bulletin in December, 1916, and has proven very useful.

In the investigations made with the rotundifolia grapes, considerable progress has been made and the reports on this work have constituted a distinct addition to the literature on the subject of heredity and have been widely copied in journals. Something over 4,500 seedlings have now been secured by hand crossing and the most promising of these have been transplanted to permanent places. This work, in addition to the special work being done at the Pender Branch Station in coöperation with the U. S. Department of Agriculture to improve the scuppernon type of grape, is adding much valuable data to the records of the Station.

#### VETERINARY SCIENCE.

In this Division the principal work has been in the study of the prevalence and control of "contagious abortion." This has been done in herds of cattle, in horses, swine and sheep out over the State and in laboratory examinations at the Station. In addition to this, workers have been called upon to perform autopsies on animals under experiments for other divisions; visits were made to sick animals of the State; and slaughter examinations were made on experimental animals to be used for market purposes.

#### PLANT PATHOLOGY AND BACTERIOLOGY.

Investigations in this Division have been centered largely on tobacco wilt and its control, apple root rots, lettuce drop, watermelon wilt and the production of varieties resistant to wilt; soybean and cow pea wilt and other studies, some of which are being made in connection with the



other divisions of the Station. Among these is the determination of the cause of trembles, or milk sickness in animals in western North Carolina and the experiments have shown this to be produced by a weed known as the White Snake Root or *eupatorium urticæfolium*.

It has been found that soybeans are affected with a wilt or blight disease, caused by an organism identical with that which causes cow pea wilt.

The results of the tobacco wilt work are reported in Bulletin 562 of the U. S. Department of Agriculture, in coöperation with this Station, and show that a proper system of rotation is necessary for its successful control.

The other activities of the Division have been in making a plant disease survey in the State and in contributing information relative to the more common plant diseases.

#### MARKETS AND RURAL ORGANIZATION.

The Division of Markets has concerned itself as heretofore with a study of matters relating to grading, marketing and financing. Investigations of prices received by farmers for various commodities, the proper marketing of these commodities, the issuance of weekly price reports, and market news service, the forming of marketing and credit associations and the grading and classing of cotton have been among the main studies involved. The daily market wire service maintained during the year in coöperation with the Bureau of Markets of the Federal Department of Agriculture for Irish potatoes, sweet potatoes, cantaloupes, watermelons and apples, proved to be of tremendous value to growers in preventing the shipping of much perishable products to markets already overcrowded.

The listing of buyers and sellers of farm produce has also been an important activity.

Growers, buyers, and mills have become interested in the cotton grading work and the commissioners of eight of the leading cotton-producing counties have made the necessary appropriation to conduct this work this year. This grading work has shown that a large part of the cotton produced in this State is above middling, and it has been the means of saving cotton growers considerable money by furnishing them with this knowledge. The cotton grading and marketing work is cooperating with the Bureau of Markets of the Federal government.

The Division has coöperated with the Federal Land Bank at Columbia by aiding in the organization of Farm Loan Associations and in forwarding applications for loans to the bank.

#### DRAINAGE.

Five major lines of investigations have occupied the activities of the Division of Drainage during the past year and these may be grouped under the headings of (1) farm drainage and terracing surveys and

investigations relative thereto, such as the proper spacing and depth of under drains, or the methods of arrangement and spacing of terraces on slopes where needed; (2) the collection of run-off data in drainage canals; (3) preliminary examinations and reconnaissance work for large drainage undertakings; (4) maintenance work on drainage canals and (5) studies relating to the efficiency of under drains. Along all of these lines considerable work has been accomplished and many facts of importance recorded.

During the year preliminary surveys, and reports for tile drainage systems have been made on twenty-seven farms in eighteen counties, comprising a total area of 12,000 acres. Over 18,500 acres have had preliminary or reconnaissance examinations made. Examinations have also indicated that new drainage canals should require annual attention only after having been in use for a period of three or four years. This attention requires the removal of silt, weeds, logs and other obstructions, so that the water may be confined to a straight, narrow channel.

#### PUBLICATIONS.

Many multigraph circulars and letters relating to the work of the Experiment Station have been distributed to select mailing lists during the past year. The press has also been furnished with the findings of the Experiment Station and considerable data have been published in the *Extension Farm News*. Much effort was made along publicity lines with a view to increasing food production in the State and conserving it after being produced. Both the weeklies and the dailies have coöperated in using the matter sent out from the Station.

One bulletin, No. 237, "Tobacco Culture in North Carolina," with forty pages, and 15,000 copies was issued. Three Technical Bulletins, Nos. 11, 12, and 13, with a combined issue of 16,000 copies; and two circulars, Nos. 34 and 35, with a combined issue of 11,000 copies, have also been printed and mailed out.

The total number of names in the mailing lists now approximates 75,000, and it is attempted to keep these lists up to date.

The following are the publications issued:

#### BULLETIN

- No. 237. Tobacco Culture in North Carolina. By E. H. Matthewson and E. G. Moss.

#### TECHNICAL BULLETINS

- No. 11. Self Sterility in Dewberries and Blackberries. By L. R. Detjen.  
No. 12. Inheritance of sex in Vitis Rotundifolia. By L. R. Detjen.  
No. 13. Biological Investigation of Sphenophorus Callosus Oliv. By Z. P. Metcalf.

#### EXPERIMENT STATION CIRCULARS

- No. 34. Soybean Products and Their Uses.  
No. 35. Velvet Beans—How to Grow and Use.

The reports of the heads of the several Divisions and financial statement follow:

## FINANCIAL REPORT

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### THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

in account with

THE UNITED STATES APPROPRIATIONS, 1916-1917.

| DR.                                                                                                                                                                                                                              | <i>Hatch<br/>Fund</i> | <i>Adams<br/>Fund</i> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|
| To receipts from the Treasurer of the United States,<br>as per appropriations for the fiscal year ended June<br>30, 1917, under acts of Congress approved March 2,<br>1887 (Hatch Fund), and March 16, 1906 (Adams<br>Fund ----- | \$ 15,000.00          | \$ 15,000.00          |
| CR.                                                                                                                                                                                                                              |                       |                       |
| Salaries -----                                                                                                                                                                                                                   | \$ 7,540.00           | \$ 12,423.06          |
| Labor -----                                                                                                                                                                                                                      | 3,457.84              | 438.74                |
| Postage and stationery -----                                                                                                                                                                                                     | 283.55                | 169.77                |
| Freight and express -----                                                                                                                                                                                                        | 94.51                 | 67.32                 |
| Heat, light, water, and power -----                                                                                                                                                                                              | 236.43                | 172.14                |
| Chemicals and laboratory supplies -----                                                                                                                                                                                          | 164.30                | 416.35                |
| Seeds, plants and sundry supplies -----                                                                                                                                                                                          | 539.81                | 228.11                |
| Fertilizers -----                                                                                                                                                                                                                | 567.57                | 120.35                |
| Feeding stuffs -----                                                                                                                                                                                                             | 658.10                | 204.88                |
| Library -----                                                                                                                                                                                                                    | 100.00                |                       |
| Tools, machinery, and appliances -----                                                                                                                                                                                           | 200.00                |                       |
| Scientific apparatus and specimens -----                                                                                                                                                                                         | 27.25                 | 218.65                |
| Live stock -----                                                                                                                                                                                                                 | 146.50                | 108.05                |
| Traveling expenses -----                                                                                                                                                                                                         | 218.12                | 432.58                |
| Contingent expenses -----                                                                                                                                                                                                        | 20.00                 |                       |
| Buildings and land -----                                                                                                                                                                                                         | 746.02                |                       |
| Total -----                                                                                                                                                                                                                      | \$ 15,000.00          | \$ 15,000.00          |

## THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

in account with

## FARM AND MISCELLANEOUS RECEIPTS.

Dr.

Receipts from other sources than the United States for the year  
ending June 30, 1917 ----- \$5,506.77

*Supplemental Statement.*

Cr.

|                                         |                  |
|-----------------------------------------|------------------|
| Labor -----                             | \$ 596.50        |
| Publications -----                      | 265.30           |
| Postage and stationery -----            | 5.10             |
| Heat, light, water, and power -----     | 53.38            |
| Chemicals and laboratory supplies ----- | 63.97            |
| Seeds, plants and sundry supplies ----- | 73.62            |
| Fertilizers -----                       | 796.20           |
| Feeding stuffs -----                    | 1,431.11         |
| Library -----                           | 209.15           |
| Tools, machinery and appliances -----   | 263.28           |
| Furniture and fixtures -----            | 158.33           |
| Traveling expenses -----                | 179.64           |
| Contingent expenses -----               | 40.00            |
| Buildings and land -----                | 571.79           |
| Balance -----                           | 839.00           |
|                                         | <hr/> \$5,506.77 |

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the North Carolina Experiment Station for the fiscal year ending June 30, 1917; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasury of the United States are shown to have been \$30,000, and the corresponding disbursements \$30,000, for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving nothing.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress, approved March 2, 1887, and March 16, 1906.

(Signed) W. H. RAGAN,  
W. E. DANIEL,  
T. T. THORNE,

*Auditors.*

(Seal)

Attest: A. F. BOWEN, Custodian.



## REPORT OF THE DIVISION OF AGRONOMY.

*To the Director:*

During the year, workers of the Agronomy Division have been quite active, and considerable information of a permanent nature has been secured and given to the people. As heretofore, the main work of the Division has been in mapping the soils of the State in a systematic way; in studying the plant-food requirements of the different types as found in different parts of the State; in working out rational systems of crop rotation that may be used, not only for affording good immediate financial returns but also for building up the fertility of the soil; and in the improvement of many of our farm crops by the use of proper methods of seed selection.

## FIELD STUDY AND CLASSIFICATION OF SOILS.

In order that the results of experimental work may be applied intelligently, not only is it necessary to know definitely the types of soil on which the work is being conducted, but in addition, it is very essential in giving advice to farmers in talks at farmers' meetings, in writing bulletins, in answering correspondence, and in other ways to know the type of soil to which the results are applicable. It is not generally safe to make any iron clad recommendations for the State with reference to the plant-food needs of soils. Even in the Piedmont section it has frequently been found that with some soils the plant-food requirements are quite different from other types occurring in the same county and in close proximity.

Realizing the necessity for having definite information with reference to soils and the boundaries of the different types in the several counties of the State, soil survey work was started in North Carolina many years ago. This work has been pushed actively during the past four or five years. At the present time there are three State and three Federal men devoting their time entirely to this work of identifying and mapping the soils. It is a source of considerable pride that North Carolina was one of the first states to take up this work in a systematic way. It is generally recognized that the work in North Carolina is being conducted in as systematic and intelligent manner as is being done in any other state in the Union. This work is being carried on in coöperation with the Bureau of Soils of the U. S. Department of Agriculture.

Since the last report, surveys have been made and reports prepared for publication for Stanly, Cleveland and Beaufort counties. At the present time field parties are at work in Caldwell, Wilkes and Orange counties. The work in these is nearing completion at the present time Bertie County has been more than half mapped, but work on it had to be discontinued on account of the field man getting sick.

The following are some of the ways in which the soil survey work has proven of value to farmers and agricultural workers of the State in their work with farmers:

1. It provides county agents and other Extension workers with definite first-hand reliable information with reference to the general agriculture existing in the county and section in which they may be working at any time.

2. It provides all agricultural workers with a definite basis on which to apply the results which have been secured or may be obtained in the future in experimental work to the different types of soil of the State.

3. It has not been an infrequent thing to find farmers who have been living on a certain type of soil and who were spending their time and money in experimenting on some problem which had already been worked out by the Experiment Station. Time and money might have been saved such persons had they known of certain results published by the Station for a certain type of soil which were directly applicable to their farms because their soils were of the same type as those studied. In all probability, therefore, the needs were the same, in the main, for the most profitable and economical growing of crops.

4. It enables a farmer living in a county where a soil survey has been made and a report issued to describe his soil in a definite way so that the person answering an inquiry may do so most intelligently, rendering the greatest service.

5. Farmers are demanding definite and specific information with reference to the needs of their soils. As indicated above, it is only possible for us to supply this in the most satisfactory way by having the soil survey results on the leading types of soil.

6. The survey is valuable in that it gives those who are growing specialized crops an idea as to where they may find soils best suited for the growing of these special crops in other communities of the State other than those of their own. This information is valuable for supplying to those outside who are seeking to buy lands within the State, especially who wish to grow special crops.

7. The chemical analyses of soils gathered in the soil survey give, in a definite way, the total amount of plant-food constituents in the soils. With this information a safer idea may be found of the plant-food requirements of any particular soil than would otherwise be the case if sole dependence was put upon the results of field trials. It has been found in some cases that with soils very low in one of the plant-food constituents, growing crops do not show this to be the limiting factor at the present time. As it requires a certain amount of each of the different plant-food constituents to produce a unit weight of crops, it is not difficult to calculate that with such soils constituents as are contained in very small quantities, it will not be long before these will become limiting factors, if provision is not made for supplying them in available form. Again the analyses, as is the case

with the Cecil series of soils in the Piedmont section of the State, show that in many cases the plant-food constituents which are contained in least quantities in the soil are the ones that are at present time the limiting factors in crop growth. For instance, with these soils the content of nitrogen and phosphoric acid is low and field experiments show, too, that in order to get the best paying results with these soils generally, materials carrying these two constituents in available form must be supplied to the soil of this series.

*Working out the Deficiencies and Needs of Our Soils.*—In order to determine the needs of the leading types of soil of the State, there has been put out on these a large number of field experiments, which were designed to work out the limiting factors in crop growth, with particular reference to their plant-food deficiencies and needs when different crops were grown on them. This work is being carried on by the Division of Agronomy in a detailed way on the Central Farm at Raleigh, and on the Test Farms located at Swannanoa, Statesville, Oxford, Willard, Kingsboro and Wenona. Supplementing this work, there are soil-type fields located in different parts of the State on different types of soil. These latter experiments are carried on in coöperation with the farmers who have farms on the type of soils to be studied, and who are sufficiently interested and patriotic to take the necessary pains to see that the details of the work are properly carried out. In this latter work, close and sympathetic supervision is exercised by the Division. An employee of the Division is always sent to see that the fertilizer is weighed out and put in properly on the right plots and that the seed are planted as should be in work of this kind. During the growing season, visits are made to these fields to see that the work is progressing satisfactorily and to take notes on the growth of the crop on the different plats. At the end of the growing season the crop is harvested and weighed by some one connected with the Division.

The soil-type fields are conducted on the following types of soil and in the counties indicated:

| <i>Soil</i>                     | <i>County</i> |
|---------------------------------|---------------|
| Porter's Clay.....              | Transylvania  |
| Toxaway Silty Loam.....         | Cherokee      |
| Porter's Loam.....              | Buncombe      |
| Toxaway Loam.....               | Buncombe      |
| Cecil Clay Loam.....            | Iredell       |
| Cecil Sandy Loam.....           | Gaston        |
| Iredell Loam.....               | Mecklenburg   |
| Mecklenburg Clay Loam.....      | Cabarrus      |
| Cabarrus Silt Loam.....         | Union         |
| Durham Sandy Loam.....          | Granville     |
| Norfolk Coarse Sand.....        | Richmond      |
| Norfolk Sand.....               | Pitt          |
| Norfolk Fine Sandy Loam.....    | Edgecombe     |
| Coxville Silt Loam.....         | Perquimans    |
| Portsmouth Fine Sandy Loam..... | Washington    |
| Muck.....                       | Currituck     |
| Norfolk Fine Sandy Loam.....    | Pender        |

In connection with many of the Farm Life schools, demonstration experiments have been started on the types of soil prevailing on the farms connected with these schools. It is believed that this work will not only help up determine the plant-food requirements of the soils studied, but the results secured will be of much value to the teachers of Agriculture in these schools in their class work. Not only this, but such work should be an effective means of interesting the patrons of the schools in the work of the farm, as the lessons taught by the results should be of value to many of them in their farming operations.

At the present time this work is being conducted in coöperation with the following schools of this type:

| <i>School</i>                         | <i>County</i> |
|---------------------------------------|---------------|
| Pleasant Garden Farm Life School..... | Guilford      |
| China Grove Farm Life School.....     | Cabarrus      |
| Lowe's Grove Farm Life School.....    | Durham        |
| Parris Agricultural High School.....  | Durham        |
| Red Oak Farm Life School.....         | Nash          |
| Philadelphus Farm Life School.....    | Robeson       |
| Sand Hill Farm Life School.....       | Moore         |
| Jamestown High School.....            | Guilford      |
| Farm Life School.....                 | Craven        |
| Dallas Farm Life School.....          | Gaston        |
| Wakelon High School.....              | Wake          |

In all of these tests there is included a plot to study the value of stable manure as a carrier of nitrogen. The tests at the farm life school at Dallas have been planned mainly to work out the value of different amounts of lime applied to soils when leguminous crops suitable for growth in that section are grown each year in rotation. On this field, as well as those at the Central Farm at Raleigh, the amount of lime per acre used is varied from 2,000 pounds of calcium carbonate to 8,000 pounds per acre. In the experiments, the lime has been used in connection with what is considered a requisite amount of available phosphoric acid to meet the needs of the growing crop. To give an idea of the rotation which is being used, the one planned for use at the Central Farm might be given as an example. It is as follows:

First year—Velvet beans sown in the spring, followed by a fall seeding of rye.

Second year—Corn, with cowpeas sown in the corn and followed by a seeding of oats and vetch in the fall.

Third year—Oats and vetch, followed by soybeans in summer and red clover in fall.

Fourth year—Cotton, with crimson clover sown just before or just after the first picking.

Soybean meal has been added to the list of those nitrogenous materials, which the relative value is being studied, as carriers of nitrogen as a plant-food constituent for crop growth. This would seem advisable in view of the fact that a goodly amount of soybeans have



been crushed by the oil mills of the State during the past two years and this meal is being sold largely for fertilizing purposes. The tests are being conducted on the Iredell, Edgecombe and Central farms.

At the Wenona test farm on muck soil, fertilizer experiments have been conducted to study the plant-food needs of this type of soil at the present time. In these experiments which have now been conducted for two years, there are included those that had different fertilizer combinations with and without lime. During the spring, more detailed lime experiments were put out on this farm to study the relative value of different carriers of lime, and to determine the best quantity per acre to use in order to get the best paying results. The applications, per acre, have run from two to eight tons of calcium carbonate from marl per acre. Other plots carrying other forms of lime have been put out carrying the same equivalents of actual lime.

At the Buncombe Farm in the rotation plots, wheat has been grown every year with an application of a complete fertilizer on one of the plots. The yields on this plot have steadily decreased. On the checked plot to which no fertilizer has been applied, the yields are so small at the present time that it is practically impossible to harvest the wheat. The yields on the plot receiving an application of stable manure are holding up very well. The plot which has received an application of lime in connection with a complete fertilizer and where red clover is used in the rotation, the yields have steadily improved. The value of lime in promoting the growth of legumes on practically all of the plots at this farm has shown up more markedly during the past year or so than formerly.

The rock phosphate experiments have shown fairly good yields, but in no case has this phosphate given as large yields or as profitable yields as acid phosphate when used alone, with manure, with potash and legumes, or with lime-potash-and-legumes. From the study thus far of Mountain soils, it has been found that phosphoric acid is the constituent of first importance. Next, nitrogen will come generally and lime with upland soil, and lime and nitrogen with bottom soils. The nitrogen is not nearly so important a constituent to be added to the bottom soils as it is with soils in the uplands.

Generally, the soils of the Piedmont section show the greatest lack of nitrogen, phosphoric acid and lime. These constituents at the present time are, therefore, the limiting factors in the most profitable plant growth. Very little benefit ordinarily with general crops like cotton and corn is secured from application of materials carrying potash. Especially is this so when this constituent is as high in price as it is at the present time. Even in the Piedmont section of the State there are certain types like the Iredell Loam in Mecklenburg and other counties that do not show any need at the present time for application of materials carrying phosphoric acid in available form, provided these soils are handled properly.

Most of the soils studied in the Coastal Plain section of the State show the main plant-food deficiencies to be nitrogen, potash, lime and phosphoric acid. On many of the black soils, high in nitrogen content, at present, crops show a marked increase in yield from the use of applications of nitrogen in available form. These results are not expected to continue after this type of soil has been brought into suitable condition for the growing of crops. These soils are well supplied potentially with nitrogen for the growing of large crops for a long time to come, but it is not in a form which the crops can use it. The phosphoric acid and potash in these soils, too, is contained in much larger quantities than has usually been the case with soils of this type found in other parts of the country. From a study of the soils of the State, it should be said that the incorporation of decaying organic matter is of prime importance at the present time. On most of the soils this material is so deficient that small applications of stable manure or the turning into the soil of a small growth of crops or crop residues will, in most cases, materially increase the yields.

It might be stated in this connection that in order to build up the productivity of the soils, it will be necessary, in practically all cases, for farmers to use leguminous crops in their rotations and to have a part of these at least to go back into the soil to increase the supply of organic matter and at the same time to add to the soils an increment of nitrogen which was taken from the unlimitable supply of the air by the plants. Although nitrogen is the main limiting constituent, as indicated above, with most Coastal Plain soils low in organic matter, yet, in most cases suitable carriers of phosphoric acid and lime have to be applied, if the best and most profitable system of agriculture is to be practiced by the farmers of this section of the State.

For some time we have been looking forward to the systematic publication of county soil reports. Since our last report, there has been prepared and issued reports of this nature for Mecklenburg, Gaston, Union and Cabarrus counties. In these reports is given definite information with reference to the agriculture, climate, and soils of the county. The recommendations given in the reports are based upon a scientific examination of the soils and upon carefully conducted field experiments on the leading kinds of soil found in the counties. It is believed that these reports will not only be of great value to agricultural workers who are devoting their time to the upbuilding of the agriculture of the different counties, but that it will be of great direct practical value to the farmers of the counties themselves.

The soil chemist with the hearty coöperation he has secured from the laboratory of the State Chemist, has analyzed samples of soil taken in soil survey work to the number of 106. The total number of soil samples taken since my last report to you, on which partial analyses have been made, have been 272.

## POT CULTURE EXPERIMENTS.

Pot Culture experiments have been made to determine the relative availability of plant-food constituents when carried in various soil-forming minerals; the value of phosphoric acid contained in basic slag as compared with that carried in acid phosphate, finely ground phosphate rock, neutral sodium phosphate, and double superphosphate; and the immediate and ultimate needs of muck soils for the most profitable crop production.

*Soil-Forming Minerals.*—These experiments were begun in 1916 with the common soil-forming minerals that occur in North Carolina soils, and has been continued during the present year. Four crops, two of legumes and two of nonlegumes have been grown in the pots after applications of the different soil-forming materials had been carefully weighed and applied. The results thus far secured indicate rather wide differences in the availability of potash, phosphoric acid and lime when supplied in these different minerals. A publication is now in progress of preparation covering the results that have been obtained in potash minerals of our soils.

*Experiments With Basic Slags.*—In these experiments two crops—Dwarf Essex Rape and German Millet—have been grown thus far. These have been harvested from the pots, weighed and analyzed. From the data thus obtained, it would appear that the phosphoric acid contained in basic slag can be assigned a value closely approximating that contained in available form in acid phosphate and double superphosphate with the types of soil studied.

*Study of Muck Soils.*—The pot and laboratory experiments which have been previously reported, have, too, been continued during the year. These experiments are designed primarily to determine the best methods that will have to be used in the treatment of this class of soils found to such large extent throughout certain parts of the eastern portion of the State. It has been found that lime, as previously reported, is still showing decidedly beneficial effects. In fact, without the addition of materials carrying this constituent in both the field and pot experiments crops did not develop at all normally.

## STUDIES ON THE CAUSE OF SOIL ACIDITY AND THE EFFECT OF CERTAIN FERTILIZING MATERIALS IN INCREASING ACIDITY.

With the hydrogen electrode apparatus, a number of typical soils of this and other states have been carefully examined. It has been rather conclusively demonstrated from the data thus far secured that true acids exist in a majority of the soils that have been studied. Samples from the "long time" fertilizer plots of the different Test Farms have been subjected to this line of investigation and the results of these studies indicate that:

1. Acid phosphate, when added to the soil in the quantities usually applied, does not increase the acidity of the soil.

2. Sulphate of ammonia, when applied as a fertilizing material to the soil, increases the acidity of the soil to a greater extent than does sulphate of potash.

3. Nitrate of soda, as might have been expected, has been found to reduce soil acidity.

The detailed results of these experiments with the deductions from the same have been put in shape for publication. An article embodying these data will shortly appear in the *Journal of Agricultural Research* of the U. S. Department of Agriculture.

#### WORK IN THE IMPROVEMENT OF FIELD CROPS.

During the year a large amount of work has been done on the Central and Branch Station Farms in the testing and improvement of varieties and strains of cotton, corn, oats, wheat, rye, soybeans and cowpeas. Long ago it was determined that work of this nature must, to a large extent, be carried on in the section or community in which the varieties are to be grown, if it is to be of the greatest value.

A detailed study of the inheritance and association of plant qualities in cotton has been made in the field. This work consists of a study of the economic qualities of the cotton plant, with special reference to its mode of inheritance and association in the plant.

During 1916 the progeny of seventy-two plants were grown and studied. From this progeny lot, 2,500 plants were carefully studied in the field in regard to their inheritance of height, of height to first branch, number of bolls, yield per plant, number of branches, number of nodes, size of boll, length of staple, per cent of lint, earliness of seed.

In this study attention has been paid to both the poor and good qualities. In ordinary selection one saves only the plants that have good qualities, consequently we know very little about the inheritance and behavior of the poor qualities. We know very little about their influence on yield, uniformity and quality of the crop. In these studies, an effort is being made to preserve both the poor and the good in order that we may better understand the inherited qualities found in an ordinary variety of cotton. The different qualities are being isolated and kept pure by self-fertilizing the plants and keeping the seed of each plant separately. During the two years of self-fertilization, the plants have not shown any evidence of lack of vigor.

During the course of the above studies, several distinct strains have been isolated from the King's Improved type, started with. For instance, strains like Cook, Cleveland, Culpepper, and Toole, have been isolated from this one variety. In fact, the strains isolated from this variety when grown side by side on uniform land show as great or greater differences than the varieties in the regular tests.



The work thus far has shown that the lack of uniformity and poor yield in ordinary varieties of cotton is due in part at least to mixtures of characters. This undesirable mixture of characters, such as short lint, poor yield, and lateness, is inherited, but may be eliminated by careful, persistent and intelligent field selection.

### *Cotton-Breeding Work on the Test Farms.*

As a result of carefully conducted cotton-breeding work, the Central Farm at Raleigh and the Iredell Farm have been stocked with pure cotton seed. This has been done with seed of strain No. 29, which was isolated from King's Improved at the Experiment Station farm in 1914. Good yielding strains also have been selected and multiplied at the Edgecombe and Pender Farms. At Edgecombe, the selections have been made from Mexican Big Boll variety. This variety is an early big boll type, which has one and one-eighth inch staple of a fairly uniform quality. The Pender Farm has been restocked with a good strain of Cleveland Big Boll cotton. Selections of individual plants have been made to further improve the strain for that section.

*Experimental Corn-Breeding on Farms.*—The seed corn of the Experiment Station, Buncombe, Iredell and Edgecombe Farms, is being improved in yield by selecting seed from individual plants and by ear-to-row testing. Each year the best strains are being turned over to the respective farms for seed planting purposes. By this means the quality of the corn on the different farms is gradually being improved.

### *Summary of Results of Tests of Varieties of Corn.*

During the past season, corn variety studies were conducted at six of the experimental farms. These farms have been so located as to represent the more important soil types and climatic conditions of the State. Among the forty varieties tested, there were included a few of the best varieties from the neighboring states, several of the most promising varieties grown more or less generally throughout North Carolina, and a few varieties grown to considerable extent in certain restricted localities of the State. The results of such tests will furnish corn growers of the different sections with reliable information regarding the yielding power of the main varieties of corn grown in the different communities of the State. As a result of the tests, a few growers have already discarded old mixed varieties of seed, adopting seed of the better yielding and more uniform strains of varieties.

In addition to the comparison of yields of grain, the varieties have been studied with reference to their suitability for silage purposes. This work has shown that the best varieties of corn for silage are the ones that produce the largest quantity of digestible food per acre. Since the ears contain 63 per cent of digestible nutrients of the corn plant on an average, it is highly important that an ensilage corn produce a large

quantity of ears as well as stalks and leaves. The results of this work have been reported in detail in the February, 1917, Bulletin of the State Department of Agriculture.

The results of variety tests of corn conducted during the past three years have been compiled to determine which of the varieties tested have given the best average yields in different sections of the State. At the Buncombe farm, First Generation Cross No. 182, Latham's Double, Southern Beauty, and Weekley's Improved; at the Iredell farm, Southern Beauty, Jarvis Golden Prolific and Biggs' Seven-ear; and at the Central Station farm, Biggs' Seven-ear, First Generation Cross No. 182, and Southern Beauty; at the Granville farm, Biggs' Seven-ear, Batts' Four-ear, and Latham's Double, as a result of two trials; and at the Edgecombe farm, Biggs' Seven-ear, Latham's Double and Goodman's Prolific have yielded best. As a result of trials of two years at the Washington farm, Latham's Double, Horse-Tooth and Wanamaker's Prolific have thus far proven to be the largest yielders.

#### *Best Soybeans for Different Sections.*

During the past season, the Division of Agronomy has studied varieties of soybeans on seven of the Branch Station farms in order to determine the best yielding varieties for different sections of the State. At the mountain farm, the medium-early varieties, such as Haberlandt, Austin, Virginia and Wilson Black, have given the best results. Haberlandt and Austin have produced the highest yields of seed; and Virginia and Wilson Black have given the best results for hay. At the Piedmont farm, Mammoth Yellow, Tarheel Black and Virginia yielded most seed, and Tarheel Black, Virginia and Wilson Black the largest amounts of hay; while at the Edgecombe farm, Mammoth Yellow, Tarheel Black and Tokio produced the largest quantity of seed, and Virginia, and Wilson Black the most hay.

#### *Best Cowpeas for Different Sections.*

During the past season, fourteen varieties of cowpeas were grown in an experimental way in different sections of the State to determine their comparative yields of seed and hay, when grown under the different conditions. At seven of the test farms, the varieties have been compared with each other and with soybeans too for hay and seed production. When planted in rows the soybeans have produced more hay and seed than have the cowpeas, but when planted broadcast for hay, the cowpeas have generally outyielded the soybeans.

In the mountains, Taylor, Early Red, and Monetta; and in the Piedmont section, Groit, Black Unknown and Early Red varieties have been the best seed producers, while Clay, Monetta, and Iron have produced most hay. The Red Ripper, Black and Taylor have produced the largest quantity of seed, and Iron, Wonderful and Monetta the most hay in the Coastal Plain section of the State.

*Results of Studies with Varieties of Small Grains.*

In the small grain work, varieties of oats, wheat and of rye have been grown and compared at the Experiment Station farm and at four of the branch station farms. Results of these tests have furnished a list of the varieties which do best in the different sections of the State.

All of the small grain at the Mountain farm was destroyed by the floods last season. At the Piedmont farm, Purple Straw, Leap's Prolific, Fulcaster, and Fultz were the best yielders among the wheats, and were compared both for seed and hay yield. The Appler, Red Rust Proof and Fulghum varieties have shown up well at the Iredell farm in yield of both seed and hay. At the Experiment Station farm, the Red Rust Proof, Bancroft and Appler for seed, and the Virginia Turf, Red Appler and Fulghum for hay have produced most satisfactorily. At the Edgecombe farm, the Fulghum, Red Appler and Red Rust Proof varieties of oats ranked best in the production of both seed and hay. Among the varieties of oats compared at the Granville farm, the Appler, Red Rust Proof, and Fulghum produced the largest quantity of both seed and hay. At six of the branch stations, Abruzzi rye was compared with the Common Winter rye secured from different sources. In all cases, the Abruzzi rye has matured earlier and has yielded from 2 to 6 bushels of seed per acre more than the common varieties of rye tested. The Abruzzi rye, too, has given decidedly earlier and more material for pasturage during the early spring.

*Results of Variety Tests of Peanuts.*

Variety tests of peanuts have been made at the Edgecombe farm and the Cotton Valley farm in Edgecombe County. The results of these tests were secured too late to be included in our last report.

At this farm, the varieties that yielded the largest amount per acre were Virginia, North Carolina, Improved Spanish, Virginia Bunch, Small Spanish, Jumbo, and Valencia, in the order given. A study was made of the percentage of kernels to hulls of each of the different varieties. The percentage of kernels ranged from 66.8 per cent with Jumbo, to 78.0 per cent with Small Spanish. The percentage of pops ranged from 1.1 per cent with the Virginia Bunch to 8.8 per cent with the North Carolina variety.

## PUBLICATIONS.

During the year the following publications have been prepared by the Division of Agronomy of the Experiment Station and published:

1. Tobacco Culture in North Carolina. Bulletin 237.
2. Harvesting Tobacco by Priming or Picking the Leaves as Compared with Cutting the Stalks, Bulletin 238.
3. Soybean Growing in North Carolina (reprint). Circular No. 31.
4. Soybean Products and Their Uses. Circular No. 34.
5. Velvet Beans; How to Grow and Use. Circular No. 35.

Before closing this report, I wish to express my deep gratitude to those associated with me in the Agronomy work. Whatever may have been accomplished by the Division is due largely to the interest and fidelity to duty of those who are associated with me in the work.

Respectfully submitted,

C. B. WILLIAMS,  
*Chief, Division of Agronomy.*



## REPORT OF THE DIVISION OF CHEMISTRY.

*To the Director:*

I take pleasure in submitting herewith the report of the Division for the year ending June 30, 1917. The greater part of the work for the year is embodied in five articles containing the results of investigations with cotton-seed meal. The first named article appeared in the October number of the *Journal of Biological Chemistry*; the second in the November number of the same journal; the third has been accepted for publication in the *Journal of Agricultural Research*. A summary of the principal conclusions is as follows:

METHODS OF APPROXIMATING THE RELATIVE TOXICITY OF  
COTTON-SEED PRODUCTS.

It has been found that the raw cotton-seed kernels are highly toxic to animals. After cooking with moist heat processes and expressing the oil the meal is very much less toxic than the original kernels. The experiments indicate that gossypol is the toxic principle of the kernels and that in preparing the meal this principle is extracted to some extent by the oil and is changed to some extent to a less toxic substance which we have designated as "D" gossypol.

The presence of the unchanged gossypol in the meal may be indicated by the red area produced when concentrated sulphuric acid is added to a part of the meal sprinkled on a glass slide and observed through a microscope (low power).

The quantity of unchanged gossypol may be determined by treating the meal with ethyl ether and precipitating with aniline. This compound of aniline was first prepared in this laboratory.

## IRON AS AN ANTIDOTE TO COTTON-SEED MEAL INJURY.

In previous experiments by this division rabbits were fed on cotton-seed meal 106 days when ferric ammonium citrate was added to the diet.

More recently the effect of adding iron in the form of ferrous sulphate and ferric chloride to cotton-seed meal in feeding swine was tried. There were four feeding experiments with pigs and these have shown that iron salts exert a decidedly beneficial action in preventing cotton-seed meal injury. Much larger quantities of meal are consumed, deaths have been postponed or averted and better gains have been made when an iron salt is added to the feed.

By thus controlling to some extent the toxic factor, the conclusion seems justified that cotton-seed meal injury is not due to a lack of vitamins or to deficiencies in calcium, sodium or chlorine, which ash analyses might lead one to suspect as the limiting factors in a diet of cotton-seed meal and corn.

Some of these experiments were conducted under favorable conditions for growth and others under unfavorable conditions. Under favorable conditions the beneficial effects of iron salts were more marked and under less favorable conditions they were not so marked. In these experiments there were some animals that yielded to the toxic effects of the meal notwithstanding the presence of iron salts.

Some experiments were also conducted in which wood ashes were placed in troughs easily accessible to pigs receiving cotton-seed meal. The ashes did not appear to exercise any effect in the way of overcoming the toxicity of meal, but as the lot receiving ashes made better gains it is possible that ashes improved the inorganic part of the diet.

#### GOSSYPOL, THE TOXIC SUBSTANCE IN COTTON SEED.

Since the publication in 1915 of the experiments which led us to advance the theory that the toxicity of cotton seed is due to the presence of gossypol, other explanations have been offered. One, that the injury is similar to beriberi and is caused by deficiency in diets, insufficient minerals or possibly inadequate amounts of fat soluble growth-promoting substances.

It has been determined that meal is much less toxic than kernels as stated above. The condition of cooking gives great variation in the toxicity of the meal. Notwithstanding the reduction in toxicity due to cooking, however, raw seed after extraction with ethyl ether is not only less toxic to pigs than cooked meal but it does not seem to be toxic at all. The main substances extracted by ether are gossypol and oil and gossypol is indicated by this fact as the toxic principle of the seed. We have also fed the extracted gossypol to pigs and have found it to be toxic.

We have found, however, that a diet of cotton-seed meal and corn meal has nutritive limitations and may under restricted conditions of life lead to failure in the case of pigs. Such failure, however, is a phenomenon entirely distinct from cotton-seed meal poisoning.

Outdoor exercise, access to forage and soil and improved diets tend to postpone or avert cotton-seed meal poisoning of swine.

#### CONTRIBUTION TO THE CHEMISTRY OF GOSSYPOL.

In 1899 Marchlewski isolated a crystalline product from the "foots" of cotton-seed oil by means of a tedious process of purification. He named the crystalline substance gossypol from gossyp(ium-phen)ol. This substance in an impure state had been noted by others previously.

Our experiments indicate that Marchlewski's "gossypol" was a substance containing one molecule of acetic acid in loose combinations with the phenolic body. This compound may be called gossypol acetate and the phenolic body itself gossypol.

Gossypol appears to be a constituent of the cotton plant only. It occurs in peculiar glands called "Gland dots," which are present in all

parts of the plant except the woody tissue. They are readily visible to the naked eye. The glands in the root-bark, leaf, petals and boll, as well as those of the seed, give, with sulphuric acid, a characteristic red color from which it is inferred that gossypol exists in all these. Unextracted kernels contain about 0.6 per cent gossypol, ethyl ether extract about 1.8 per cent, and kernels after extracting by petroleum ether about 0.9 per cent.

We have found it very much simpler to isolate gossypol from the seed than from the foots as Marchlewski did. Gossypol may be dissolved in ethyl ether and precipitated with acetic acid, petroleum ether or aniline, details of which methods are given in the paper referred to.

Our experiments indicate that gossypol has a molecular weight of 530 or 532 and an empirical formula  $C_{30}H_{28}O_9$  or  $C_{30}H_{30}O_9$ .

The different methods by which we were led to this conclusion are contained in the paper.

Three substance resembling gossypol, more or less, have been isolated. Two of these are yellow. The third appears to be without color. We have designated as "D" gossypol the substance formed from gossypol in cooking the seed; "B" gossypol as the substance formed by heating gossypol in the air to its decomposition point; and as "C" gossypol the colorless substance which is formed by fusing gossypol with alkalis at a high temperature.

Gossypol is oxidized in alkaline solution, a blue substance being formed first which subsequently disappears.

#### COMPARATIVE TOXICITY OF COTTON SEED PRODUCTS.

Various cotton seed products including raw kernels, ether extracted kernels, gossypol and several meals have been fed to rats, rabbits, poultry and swine.

Raw kernels and gossypol have been found highly toxic to all these animals. The toxicity is very much reduced by cooking under oil mill conditions but is still harmful to rabbits and swine. The toxic effects are very much less marked upon rats and fowls.

Milk powder appears to overcome, for rats, any toxic substance in the meal.

Rabbits are more susceptible to cotton-seed meal poisoning than rats.

Aside from apparently diminished egg production excessive amounts of cotton-seed meal have not appeared to be injurious to hens. There is some evidence that unchanged gossypol in the diet may cause a peculiar discoloration of the egg yolk.

Pigs were fed peanut meal, soybean meal, cotton-seed meal and ether extracted kernels and the latter were found to give the best results.

The time and temperature of cooking have an effect upon the toxicity. Addition of other substances as meat scrap, calcium lactate, sodium

chloride and butter fat or 10 per cent skim milk powder have exerted a beneficial effect. Green feed, open air and moderate exercise have also been helpful. We have not been able to find any feeding material which is able to overcome for swine cotton-seed meal injury. We have, however, overcome the injury by extracting gossypol from raw kernels.

Our former conclusion is thereby confirmed that gossypol is a toxic principle of cotton seed.

#### SOIL BACTERIOLOGY.

During the past year studies in nitrification and ammonification have been mainly with solutions. We have endeavored to study the effects of the presence of certain constituents in nutrient solutions and the effect of the concentration of various constituents.

We have usually found that in preparing nitrification nutrient solutions that precipitation takes place. Micro-chemical examination indicated that for the most part the precipitates were ferric phosphates, but in some solutions secondary calcium phosphate appeared to form also. The conditions appeared to be favorable for the solution of the precipitate of magnesium ammonium phosphate but we found no indication of this substance in the precipitate formed in any case.

When these solutions were filtered in order to remove the precipitate nitrification was materially retarded, indicating that the micro-organisms are able to utilize precipitates. The presence of calcium carbonate was favorable to nitrification.

Calcium carbonate appears to liberate ammonia from ammonium sulphate. A large loss of nitrogen occurred in all solutions. As this loss is usually greater in an uninoculated solution than an inoculated one, the phenomenon would appear to be chemical rather than biological. Dipotassium phosphate and ferric sulphate appear to give better results than monopotassium phosphate and ferrous sulphate, possibly on account of their lesser degree of acidity. Magnesium appears to give better results in the form of sulphate than in the form of chloride.

These conclusions are stated with some degree of hesitancy as the results are not uniform and variations occur, the reasons for which are unknown to us. We also studied the effect of the container and found that rectilinear bottles resting on their largest side during incubation gave very much better results than Erlenmeyer flasks, leading us during the latter part of our work to abandon the use of Erlenmeyer flasks for incubation purposes.

Changes in the staff of this Division have involved the resignation of Messrs. F. E. Carruth and L. B. Johnston, who resigned to accept positions elsewhere.

The Chemist to the Station has been elected, during the year, President of the North Carolina Academy of Science.

Very truly yours,

W. A. WITHERS,  
*Chemist, Experiment Station.*



## REPORT OF THE ANIMAL INDUSTRY DIVISION.

*To the Director:*

In response to your request, I am herewith handing you a report of the experimental work of the members of the Animal Industry Division for the year ending June 30, 1917.

## SWINE.

The work with feeding and breeding hogs is being conducted at the Central Station Farm at Raleigh, the Iredell Branch Station Farm at Statesville, the Edgecombe Branch Station Farm at Rocky Mount, and at the Pender Branch Station Farm at Willard. While the work undertaken has progressed satisfactorily, still many projects have had to be neglected on account of the small appropriation made to support the test farms. It is hoped that some funds can be secured for the test farms as it is not only necessary to carry on the lines of work we have under way more completely and comprehensively, but it is also necessary to inaugurate new and additional work. No live stock work at all, for instance, is being done at the Buncombe Branch Station Farm and the only reason that can be given for this neglect is that the test farm appropriations are not sufficiently large to warrant the undertaking of new live stock projects.

*Value of Soybean Pastures for Hogs.*

## (Central Station Farm.)

I judge, both from correspondence and from personal interviews with farmers, that it is very difficult for many of them to learn that it is absolutely impossible to make money with any kind of live stock unless pastures of various kinds are used as a basis. All of the live stock men are continually besieged with the question as to how money is to be made with live stock without pastures. For this reason the most of our investigational work swings around the utilization of pastures.

One of the best pastures, and one that can be used practically anywhere in the State, is soybeans. We have been making a special effort the last year to emphasize its feeding value. In this experiment the number of pigs on hand was divided into two lots. The first lot of pigs was enclosed in a small lot and fed upon a ration made up of two-thirds corn plus one-third wheat shorts. The second lot of pigs was given a ration made up of soybean pasture and no grain at all. The experiment lasted from October 9, 1916, to January 9, 1917. The first thing of interest to note in this experiment is that hogs running upon soybean pasture gained just twice as rapidly as did those which were enclosed in the lot and fed all the corn and shorts they would consume. When

this experiment was under way shelled corn was valued at \$45 a ton, wheat shorts at \$38 a ton, and soybean pasture at \$10 an acre. When these values were placed upon the feed, it cost \$13.24 to produce each 100 pounds of increase in live weight in the dry lot and only \$5.50 to produce an equivalent increase in live weight in the soybean-pasture lot. The soybean pasture was not exceptionally good. In fact, it was far below the average of the yield usually secured by farmers in the coastal section but even at this, 200 pounds of pork were produced to each acre.

*Value of Soybean Pasture for Feeding Dry Brood Sows.*

**(Central Station Farm.)**

The usual permanent pasture season ends with the coming of the frosts and with the ending of the summer pasture comes a period of expensive feeding if the farmer has not changed his grazing system and provided for something for fall and winter. In fact, the months of October, November, and December constitute a discouraging period for farmers who produce hogs. One of our lines of work is to work out a pasture system bridging over these months, and in this work we have found that soybean pastures are exceedingly valuable. In the spring of 1916 we planted 2.6 acres of soybeans with the object of using the area for feeding brood sows during the fall and early winter. The area used was an old abandoned cotton patch, where the soil had been exhausted some years previously and was over-run with a rather dense growth of Bermuda. The ground was broken in the usual way and the beans planted in rows about three feet apart. As the soil was poor, the yield of beans was only 15 bushels to the acre. On October 9, when the period of usefulness of the Bermuda pasture was passed, eight sows were turned into the soybean field of 2.6 acres. At the beginning the sows averaged 227 pounds in weight and at the close, 49 days later, or November 29, they averaged 244 pounds in weight. Not a pound of grain was fed. During this time the sows ate 40.2 bushels of soybeans, but it certainly is not fair to charge the beans against the sows at the market price, as no expense was entailed in harvesting and preparing them for the market. The sows harvested them without expense. If the eight sows had been fed upon corn alone during this time and made the gains they did make upon pasture, they would have eaten not less than one bushel of shelled corn a day, or 49 bushels for the whole period. As a matter of fact, the soybean-pasture ration, when everything is considered, certainly did not cost over \$30 for the whole time.

Just at the present time this test is being duplicated and the results, as far as we have gone, are as satisfactory as the previous one.

*Feeding Cotton-seed Meal to Hogs.*

(Central Station Farm.)

The cotton-seed meal work is being carried on in coöperation with the Chemistry Division. On account of the fact that this piece of work must be done in an extremely painstaking way and is also very expensive, it is conducted at the Central Test Farm at Raleigh. In this work we know that the gains must be necessarily small and expensive and that heavy losses are to be encountered, because cotton-seed meal has a poison in it and many of our animals are killed before the experiment continues very far. During the past year seven lots of hogs were used in this experiment but due to the scarcity of hogs, only three were used in each lot. The object of this experiment was to determine if the length of time that cotton-seed meal was cooked, during the process of making, had any effect upon the toxicity. Also to determine if other materials could be fed with cotton-seed meal to correct the ill effects of the cotton-seed meal. In addition to these two problems with cotton-seed meal, two check lots were used to determine the feeding value of soybean meal and peanut meal, as compared with cotton-seed meal. The rations used are as follows: Lot 1 was fed a ration of 25 per cent cotton-seed meal (cooked two hours), 65 per cent of cracked corn, and 10 per cent of wheat bran; lot 2 was fed 25 per cent of cotton-seed meal (cooked 24 minutes), 65 per cent of cracked corn, and 10 per cent of wheat bran; lot 3 was fed 25 per cent of soybean meal, 65 per cent of cracked corn, and 10 per cent of wheat bran; lot 4 was fed 25 per cent of peanut meal, 65 per cent of cracked corn, and 10 per cent of wheat bran; lot 3 was fed 25 per cent of soybean meal, 65 per cent of cracked corn, and 10 per cent of wheat bran; lot 4 was fed 25 per cent of peanut meal, 65 per cent of cracked corn, and 10 per cent of wheat bran; lot 5 was fed 25 per cent of ether extracted cotton-seed kernels, 65 per cent of cracked corn, and 10 per cent of wheat bran; lot 6 was fed 30 per cent of cotton-seed meal (cooked two hours), 42 per cent of cracked corn, 20 per cent of wheat bran, 3 per cent of tankage, and 5 per cent of butter plus 800 grams of a salt mixture composed of calcium lactate 350 grams, calcium phosphate 320 grams, common salt 100 grams, iron and ammonium citrate 30 grams, to each 100 pounds of grain; lot 7 was fed 30 per cent of cotton-seed meal (cooked two hours), 40 per cent of cracked corn, 20 per cent of bran, and 10 per cent of skimmed milk solids.

No definite results have been determined from this experiment and it will be continued on through this year.

*The Amount of Corn Which Should be Fed in Conjunction with Soybean Pasture.*

(Edgecombe Branch Station Farm.)

Whenever soybean pastures or any other kind of pastures are discussed as feeds for hogs the farmer is sure to ask how much corn should be fed in conjunction with pasture. This question, of course, is an extremely practical and important one. To answer the question and at the same time determine the effect of soybean pastures upon the bodies of swine, a series of experiments has been outlined and is being carried through upon the Edgecombe Branch Station Farm.

During the summer of 1916 a rather large area of soybeans was grown. This area was used in this experiment. On September 19, 1916, 32 pigs were divided into three lots. The first lot of pigs was fed in a dry lot upon a ration made up of two-thirds corn plus one-third wheat shorts; the second lot of pigs was grazed upon soybean pasture and in addition given a half ration of corn and wheat shorts; the third lot of pigs was simply given a ration of soybean pasture. The pigs at the beginning were all young and small, averaging 63 pounds in weight. None of them, therefore, made large average daily gains during the soybean period of 105 days. The gains made, however, were interesting. The pigs in the first lot (the dry lot) made an average daily gain of .36 of a pound; the pigs in the second lot (pasture plus grain) made an average daily gain of .49 of a pound; the pigs in the third lot (soybean pasture alone) made an average daily gain of .14 of a pound. As far as gains are concerned, therefore, it paid to supplement the pasture with a half ration of grain. What about the cost? In the first lot (dry lot), it cost \$17.89 to make each 100 pounds of increase in live weight; in the second lot (soybean pasture plus corn), it cost \$9.37 to make an equal increase in live weight; and in the third lot (soybean pasture alone), it cost \$19.20 to make each 100 pounds of increase in live weight. The above expenses are based upon corn at \$1 a bushel, wheat shorts at \$38 a ton, and soybean pasture at \$10 an acre. This single experiment indicates, therefore, that some grain should be fed in conjunction with soybean pasture. The work, however, is being duplicated this year with an increased number of hogs. Peanut pastures as well as soybean pastures, also constitute a part of the work now under way.

*Value of Soybean Pasture in Conjunction with Corn.*

(Cotton Valley Farm.)

To gain the confidence of some farmers, it is often necessary to project the results of our investigational work upon practical farms and in conjunction with practical farmers. Sometimes farmers feel that they cannot afford to do what the authorities of the State Agricultural Institutions recommend but when the results of our investigational work



are carried on on the farm of some practical farmer and duplicated in a large way, we have no difficulty in convincing the average farmer that our teachings are correct.

To meet just such conditions as these, we have made arrangements with the owners of the Cotton Valley Farm, Messrs. Holderness and Shook, Tarboro, N. C., to use their farms and capital in demonstrating that our test farm teachings are correct. We are, in short, using their farms to demonstrate practical, expensive, and scientific investigations on the test farms.

Last year a very large area of soybeans was grown upon the Cotton Valley Farm. On September 26, 1916, 185 pigs, averaging about 50 pounds in weight, were turned on to a large field of soybeans and fed corn in conjunction. The supply of soybeans was exhausted December 29, 1916. During this time the pigs made satisfactory gains and economical gains. When corn is valued at \$1 a bushel and soybean pasture at \$8 an acre (which is the value placed upon the feeds by Mr. Shook, the manager), it cost \$6.29 to make each 100 pounds of increase in live weight. These results are somewhat better than those secured upon the Edgcombe Test Farm. The pigs at the end of the soybean period were not, of course, ready for the market as they were soft. At this time they were placed in a dry lot and hardened for the market, but this phase of the work is reported under another heading.

The experiments on the Cotton Valley Farm are also being duplicated this fall, the object being to determine the amount and cost of pork that can be made from each acre of peanuts and also to determine the amount of pork that can be made from the gleanings after the peanuts have been harvested.

#### *Relative Value of Soybean and Peanut Pastures.*

(Pender Branch Station Farm.)

Those who have used both soybean and peanut pastures know that both of them are very valuable as feed for hogs. Many farmers, however, are asking which is the more valuable of the two. To answer the question a series of experiments is being carried through at the Pender Branch Station Farm. The first year's results were reported last year. Members of the Board who have visited the Pender Branch Station Farm know that two areas have been set aside for this work. Each year soybeans are grown upon one area and peanuts upon the other. Last year the soybeans were ready to be grazed before the peanuts so the hogs were divided into three lots, two of them being carried in small pens until the peanuts were ready, while the third one was started immediately upon the soybean pasture. The first lot of pigs was fed a ration made up of two-thirds corn plus one-third wheat shorts; the second lot of pigs was fed just half as much corn and shorts plus soybean pasture; the third lot of pigs was fed peanut pasture in place of

soybean pasture. The experiment began October 5, 1916, and closed 84 days later. During this time the pigs in the first lot (grain only), gained daily .35 of a pound; the pigs in the second lot (soybean pasture), gained .48 of a pound; while the pigs in the third lot (peanut pasture), gained 1.41 pounds daily. When shelled corn is valued at \$40 a ton, wheat shorts at \$36 a ton, and soybean and peanut pastures at \$10 an acre, it cost \$22.68 to make 100 pounds of increase in the dry lot, \$10.77 in the soybean-pasture lot, and \$5.90 in the peanut-pasture lot. It is seen, therefore, that both pastures were valuable but that the peanut pasture was more valuable than the soybean pasture. Peanut pasture has another advantage as indicated by the gains made daily. From the standpoint of the amount of pork made on each acre, there was practically no difference in the cost. The pork was made very much more rapidly on peanuts than on soybeans. This, of course, is a point in favor of peanuts.

#### *Cost of Raising Pigs to the Weaning Age.*

(Cotton Valley Farm, Iredell, Edgecombe and Pender Branch  
Station Farms.)

The average farmer finds more difficulties facing him during the suckling period of the pigs' lives than at any other time. Very little study has been given to this period of the pig's life and really no valuable information has been collected as to just what it costs to raise a pig up to weaning time and as to the best method of handling and feeding this time. Upon the three test farms indicated above and also at the Central Station Farm at Raleigh, close studies are being made and accurate data collected as to just what it costs to raise a pig. In my last report I called your attention to the fact that this work was under way. While it is not finished by any means, some interesting facts are coming to the surface. So far, we have accurate information on the cost of raising pigs from 45 sows. Upon the Iredell Branch Station Farm complete records have been secured on 13 litters of pigs and it has cost \$2.24 to get each pig to the weaning time. At the Pender Branch Station Farm 11 litters of pigs have been studied and it cost \$3.10 per pig; at the Edgecombe Branch Station Farm 12 litters have been studied and it cost \$2.04 per pig; at the Cotton Valley Farm 24 litters of pigs have been under observation and it cost \$3.18 per pig. The cost of keeping the mother is, of course, included in the above estimates.

#### *Curing Meat on the Farm.*

(Pender Branch Station Farm.)

Just at the present time the question of curing meat on the farm is a vital one. Fortunately for us, we are in position to give the people some definite information as to the best method of curing and keeping

meats. This work was inaugurated at the Pender Branch Station Farm last year and plans were made to supplement it upon the Central Station Farm. Eighteen hogs were used in the experiment. Nine of them were sold immediately after killing and nine were cured at the farm. As the prices ruled last winter \$66.92 more were received from the meat that was cured on the farm than for that which was sold fresh. This, of course, includes the returns from the lard, heads, ribs, trimmings, etc., which were sold fresh. Two different methods were used in curing the meat. One-half was put down in dry salt and the other half in a brine mixture, made of 12 pounds of salt, 3 pounds of brown sugar, 3 ounces of saltpetre, and 6 gallons of water to each 100 pounds of meat. The curing period lasted 27 days and during this time the meat in the brine shrank in weight 3.4 per cent, while that in the dry salt shrank 7.5 per cent. After the meat was taken out of the curing materials, one-half was cured with liquid or prepared smoke and the other half was cured in the old fashion way, with hickory smoke. The smoking period lasted 27 days. At the end of this time all of the meat was wrapped in paper and cheese cloth and allowed to hang in the smoke-house for 34 days and then sold. When the meat was unwrapped to be sold it was found that the fat and lean had separated to some extent on the meat that was smoked with liquid smoke, while that treated with hickory smoke had not. The meat which had been treated with hickory smoke also had a better appearance and sold much more readily. There was no noticeable difference, however, in the internal appearance of the meat or in the taste after it was cooked.

*Is it Profitable to Harden the Bodies of Hogs After They Have Been Rendered Soft as a Result of Eating Soft-Producing Feeds?*

(Pender and Edgecombe Branch Station Farms and  
Cotton Valley Farm.)

Peanut and soybean pastures are probably the cheapest feeds we have for hogs. Unfortunately, both of these pastures make soft-bodied animals and soft-bodied animals sell at a discount upon the open markets. The tendency, however, is for the farmer to sell a hog or try to sell him just as soon as these cheap feeds are gone and it is a very difficult thing to do to show him that the hardening period is in itself a profitable period. The average farmer is inclined to think that the grain fed during the hardening period is practically lost. One of our main lines of work upon the different farms is to determine just what it does cost to finish hogs for short periods of time after they have been grazing upon peanuts and soybeans. On account of the fact that this project is being investigated at three places very much material bearing upon this point is now accumulated. In a general way the results show that it does pay to harden the bodies even though the buyer fails to respond with increased prices. When, however, the purchaser

does pay extra, which is usually the case, for hard-bodied hogs, the owner of the animal profits very greatly, provided, the finishing period is not continued over 35 days. The following table gives the results of one of our completest experiments. This work was done upon the Cotton Valley Farm. It should be noted, however, that the hardening period was only 26 days, and this was not a sufficient length of time to bring soft-bodied hogs back to the proper degree of firmness.

| <i>Lot No.</i> |              | <i>Ration.</i>        | <i>No. Days.</i> | <i>Feed to make</i> | <i>Cost to make</i> |
|----------------|--------------|-----------------------|------------------|---------------------|---------------------|
| <i>No.</i>     | <i>Hogs.</i> |                       |                  | <i>100% gain.</i>   | <i>100% gain.</i>   |
| 1              | 20           | Shelled corn          | 26               | 7.1 bu.             | \$12.40             |
| 2              | 20           | Shelled corn 9-10     | 26               | 6.5 bu.             | 13.80               |
|                |              | Cotton-seed meal 1-10 |                  | 40 lbs.             |                     |
| 3              | 20           | Shelled corn 7-8      | 26               | 6.8 bu.             | 14.70               |
|                |              | Cotton-seed meal 1-8  |                  | 55 lbs.             |                     |
| 4              | 20           | Shelled corn 4-5      | 26               | 8.5 bu.             | 19.38               |
|                |              | Cotton-seed meal 1-5  |                  | 119 lbs.            |                     |
| 5              | 20           | Shelled corn 3-4      | 26               | 6.0 bu.             | 14.24               |
|                |              | Cotton-seed meal 1-4  |                  | 112 lbs.            |                     |
| 6              | 20           | Cracked corn 2-3      | 26               | 5.6 bu.             | 14.32               |
|                |              | Cotton-seed meal 1-3  |                  | 156 lbs.            |                     |
| 7              | 20           | Cracked corn 3-4      | 26               | 4.7 bu.             | 11.12               |
|                |              | Cotton-seed meal 1-4  |                  | 86 lbs.             |                     |
| 8              | 20           | Ear corn 9-10         | 26               | 9.8 bu.             | 20.82               |
|                |              | Cotton-seed meal 1-10 |                  | 61 lbs.             |                     |
| 9              | 20           | Shelled corn 9-10     | 26               | 6.3 bu.             | 14.16               |
|                |              | Tankage 1-10          |                  | 39 lbs.             |                     |

In the above table corn is valued at \$2.00 a bushel, cotton-seed meal at \$40 a ton, and tankage at \$80 a ton. The last column in the table shows that gains are very expensively made when grains are very high in price, but the price of hogs at the present time almost, if not quite, corresponds. Quoting from the Jacksonville, Florida, quotations of August 14, 1917, 180- to 300-pound good hogs are selling for \$14.75 to \$16; 150- to 200-pounds hogs from \$14 to \$15.25; 125- to 150-pound hogs from \$13.50 to \$14.25; pigs from 65 to 120 pounds from \$10.50 to \$14. Even with corn at \$2.00 a bushel, the most economical lots were finished profitably, lot 7 being notable in being extremely economical when compared with other lots. In lot 7 cracked corn and cotton-seed meal were employed and the expense of making each 100 pounds of gain was \$11.12. In other words, each pound of increase in weight during the finishing period was added profitably while at the same time the selling price of the whole body was advanced materially. Many farmers are under the impression that satisfactory daily gains are not made when hogs are taken from peanut fields and enclosed in dry lots and continued on dry feeds. This is a mistaken idea, however. The hogs in the above experiment gained daily 1.7 pounds, 1.8 pounds, 1.6 pounds, 1.5 pounds, 1.4 pounds, 1.9 pounds, 1.1 pounds, 1.9 pounds in lots 1, 2, 3, 4, 5, 6, 7, 8, 9, respectively.



*The Cheapening Effect of Peanut Pasture, Soybean Pasture, and Mast  
Upon the Bodies of Hogs.*

As you know, the workers of the Animal Industry Division are devoting much time to determining just what effect peanut pasture, soybean pasture and other feeds have upon the bodies of swine. It is necessary for us to do this because it is such a vast economical Southern problem. Some of the feeds of the South, notably peanuts, soybeans, and mast, produce soft-bodied hogs. When these hogs are placed on the market they are discriminated against from one to two cents a pound which is, of course, an enormous financial loss to the South. Just how this loss can be overcome is one of our biggest problems and it is one which we are studying in our laboratories and upon our test farms. During the past year, we secured samples from all of the hogs fed in the experiments heretofore reported. These samples have been sent to our chemical laboratory and thoroughly analyzed to determine the effects of feeds upon the bodies of the hogs fed.

We have determined, I might say conclusively, that soybean meal and peanut meal do not make soft-bodied hogs notwithstanding the fact that packers have often discriminated against hogs fed upon these meals.

Last winter and spring one experiment was carried through at the Edgcombe Test Farm to determine just what effect peanut meal and damaged peanuts have upon the bodies of hogs. Thirty-three hogs, which were raised upon the Edgcombe Test Farm, were employed in the test. The experiment was inaugurated January 26, 1916, and closed June 26, 1916, when the hogs were shipped to the Baltimore market, sold, samples of fat obtained and returned to our North Carolina laboratories for analyses.

At the beginning of the test three hogs were slaughtered, fat (kidney fat), samples secured, and the melting point determined. It was learned that the average melting point of this fat was 38.5 degrees. The pigs were young, which no doubt partially accounts for the low-melting point. It should be recalled that the fat secured from hogs which have been fattened upon corn alone melts at an average temperature of 42 to 43 degrees, and that lard which has this melting point is entirely satisfactory. The pigs used in this test were, therefore, somewhat soft at the beginning.

The 30 remaining pigs were then divided into three equal groups and enclosed in small bare lots. The pigs in lot 1 were fed the whole time from January 26 to June 26 on a ration of two-thirds corn plus one-third wheat shorts; those in lot 2 on a ration of two-thirds corn plus one-third damaged peanuts; and those in lot 3 on a ration made up of two-thirds corn and one-third peanut meal.

When these hogs were killed it was found that the first and last rations did not materially affect the firmness of the bodies of the hogs,

but the second ration, where damaged peanuts were used, had a tendency to produce soft-bodied animals. The results can be shown in a short table:

| <i>Lot No.</i> | <i>Ration.</i>         | <i>Melting Point.</i> |
|----------------|------------------------|-----------------------|
| At beginning   | Taken from run on farm | 38.5 degrees          |
| 1              | Corn 2-3               |                       |
|                | Wheat shorts 1-3       | 39.1                  |
| 2              | Corn 2-3               |                       |
|                | Damaged peanuts        | 36.0                  |
| 3              | Corn 2-3               |                       |
|                | Peanut meal 1-3        | 38.3                  |

The people who bought these hogs had no criticism to make, although all of the hogs were really somewhat soft, even those that were fattened on corn and wheat shorts, when measured by the corn standard. Many buyers would have criticised the bodies of the hogs which were fattened upon corn and waste peanuts, as the melting point was as low as 36 degrees. These hogs all started out somewhat soft and remained somewhat soft to the end, although the damaged-peanut-fed hogs were the softest.

A similar experiment was repeated at the Central Station Farm at Raleigh. The second test was begun January 28, 1916, and closed June 16, 1916, 31 hogs being employed. At the beginning of this test three average hogs were slaughtered and the average melting point of the fat was found to be 41.1 degrees, being almost as firm as fat taken from hogs fattened on a ration of corn alone. The remaining 28 pigs were then divided into three equal lots and placed in small pens, free from grass. The pigs in lot 1 were given a ration made up of two-thirds cracked corn plus one-third wheat shorts; those in lot 2 were fed a ration of two-thirds cracked corn plus one-third soybean meal; those in lot 3 were given a ration of two-thirds cracked corn plus one-third peanut meal. When these hogs were sold and killed, samples of kidney fat were taken to the laboratories for analyses. The final results were as follows:

| <i>Lot No.</i> | <i>Ration.</i>   | <i>Melting Point.</i> |
|----------------|------------------|-----------------------|
| At beginning   | Grain mixture    | 41.1 degrees          |
| 1              | Corn 2-3         |                       |
|                | Wheat shorts 1-3 | 41.9                  |
| 2              | Corn 2-3         |                       |
|                | Soybean meal 1-3 | 42.0                  |
| 3              | Corn 2-3         |                       |
|                | Peanut meal 1-3  | 42.1                  |

The bodies of these pigs were firm when the test was inaugurated and continued to become firmer as the experiment continued. At the end the softest hogs were found in lot 1 where corn and wheat shorts were fed—

the firmest bodies being found in the lots where soybean meal and peanut meal were employed. The bodies were all satisfactory. It may, therefore, be said in conclusion that the results so far secured seem to show that soybean meal and peanut meal do not produce soft-bodied hogs.

Upon the Cotton Valley Farm, where large numbers of hogs were used, we have found that the bodies of soft hogs can be brought back to a corn standard in something less than 48 days. The kidney fat taken from the bodies of hogs which have been fattened upon corn alone have a melting point of about 43 degrees. This is satisfactory to the packers or any one else. Upon the Cotton Valley Farm some hogs were fattened upon soybean pastures. At the end of the soybean-pasture-period they had a melting point of 28.6 degrees, or the lard was practically oil. Forty of these hogs were put up in a dry lot and finished for 48 days on a ration of corn, cotton-seed meal, and peanut meal and at the end of this time the melting point was raised to 44.2 degrees. This was somewhat firmer than we expect to secure when corn is fed alone. Forty-eight days is, of course, too long a period to be economical. Our problem is, therefore, to shorten the period in some way.

Upon the Edgecombe Branch Station Farm some hogs which were fattened upon soybean pastures came off with a melting point of 31.5 degrees. The markets would discriminate against them probably 1½c a pound. These hogs were then put up in a dry lot and fed 36 days on corn and shorts, when they had a melting point of 39.2 degrees. The bodies even then were somewhat soft and would have been discriminated against upon an open market.

This line of investigational work is yielding some of our most satisfactory and profitable results. It is hoped that we will be in position before very long to make definite recommendations as to just how long it will take to harden soft-bodied hogs and just what the best feeds are. We, no doubt, know even now the best combinations of feeds, although all combinations have not as yet been tried out. So far, however, we have found nothing equal or even comparable to cotton-seed meal for hardening soft hogs.

#### BEEF CATTLE.

The investigational work, under the direction of Mr. Curtis, has been done at the Central Station Farm at Raleigh, upon the farm of T. L. Gwyn, of Haywood County, and in coöperation with Holderness and Shook, of Tarboro, upon the Iredell Branch Station Farm, and upon the Edgecombe Branch Station Farm

#### *Trembles or Milk Sickness.*

(Central Station Farm.)

People who live in the mountains know that there is an extremely dangerous disease in that part of the State which when occurring in

animals is called Trembles, and when occurring in humans is called Milk Sickness. The cause of this disease has been a mystery for over one hundred years and during this time the losses among live stock have been enormous and many humans have died as a result of drinking milk from animals having the disease.

In July, 1916, the Animal Industry Division, under the direction of Mr. Curtis, inaugurated an investigation to determine, if possible, the cause of this mysterious disease. Later on Dr. Wolf, of the Botany Division, was brought into the investigation and Dr. Kaupp, of the Animal Industry Division. Sheep were used as a basis for the study on account of the fact that cattle are too expensive. Some time ago a physician of the North, Mosely, claimed that White Snakeroot, locally known in North Carolina as Richweed, was the cause of Trembles in animals. His claims, however, were given no credence by investigators until the matter was taken up by this Division. The experiment is carried on by gathering the green weed in Clay County and shipping it to Raleigh, where it is fed to animals. During the months of June, July, August, September, and October, 1916, fifteen cases of Trembles in sheep were developed by feeding them various amounts of Richweed. Fourteen of these resulted fatally and one recovered. Death resulted in from five to twenty-five days following the beginning of the feeding of the weed. Considerable variation existed among the ewes, some succumbing to the disease much more readily than others. It is very often claimed that salt and soda have curative properties. Both of these chemicals were tried during the first year's work but without apparent antidotal effect.

During the summer just past, the work was continued further. Six ewes were fed on Richweed and the lambs allowed to suckle to determine whether the Trembles is transmitted through the milk. Two typical cases of Trembles developed in the lambs. Six dry ewes were also fed on Richweed to corroborate the work of last year. All of the ewes were lost with typical cases of Trembles as were also the ewes in the first experiment when the milk flow ceased. Mr. Curtis and Dr. Wolf have extracted the juice from the plants and found it to be exceptionally poisonous and it also produced typical cases of Trembles. Dr. Kaupp has studied the pathological phases in all of the animals under investigation. Chemical analysis has also been started under the direction of Mr. McCarty for the purpose of eliminating the specific poisonous principle.

It is difficult, of course, to get the farmers to accept our results. To establish confidence, three field experiments have been started in Clay County with Mr. M. R. Penland, with Mr. E. S. Millsaps, Jr., in charge, one at the Sheep Experimental Farm in Mitchell County, and one at the farm of Mr. T. L. Gwyn of Haywood County.

Vast good is sure to flow from the results of this investigation, as it seems now that the disease can be controlled easily by simply destroying the Richweed.



*The Effect of the Continued Feeding of Cotton-Seed Meal to  
Breeding Animals.*

(Central Station Farm.)

In my report of last year, I gave in some detail, the results of this investigation. Mr. Curtis and Mr. Eaton are continuing it but on a smaller basis. It was found necessary to do this on account of the lack of funds. Just now, three heifers are in the test but it is planned, if funds are available, to put the work on an extensive basis and to cover a period of five years or more. The three heifers which were continued in the work gave birth to normal calves during the summer, thus indicating that under certain conditions high rations of cotton-seed meal are not necessarily dangerous. These heifers were fed abnormally heavy rations of cotton-seed meal but with a view of getting unsatisfactory results, if possible. During the summer they were fed a half ration of cotton-seed meal based on 1 pound of cotton-seed meal to 100 pounds of live weight. During the winter this was increased to a full ration, averaging about 12 pounds per animal per day. Even with these large amounts two or three heifers have dropped normal calves.

*Value of Velvet Bean Meal for Beef Cattle.*

(Central Station Farm.)

Hundreds of inquiries are coming to our offices asking about the value of Velvet bean meal as a feed for beef cattle, dairy cattle, hogs, horses, and poultry. As this is a new feed, practically no work has been done to establish its true value. To place us in position to at least partially answer these question, Mr. Curtis last spring bought a carload of young cattle and divided them into two lots and is making a direct comparison of cotton-seed meal with velvet bean meal, when fed in conjunction with corn silage. This experiment does not close until November 1, or possibly later, so it is impossible to give the results just yet. The work has progressed far enough, however, to determine that velvet bean meal is very much inferior to cotton-seed meal for feeding beef cattle as 7 pounds of velvet bean meal are required to produce gains as rapidly as 5 pounds of cotton-seed meal.

*Wintering Steers and Yearlings.*

(T. L. Gwyn Farm, Haywood County.)

The beef cattle investigational work which has perhaps exercised the most influence in the State, has been the work done in coöperation with T. L. Gwyn, where a study has been made of various methods of getting steers through the winter months. I have, from time to time, reported the progress of this work. It is still being continued and the work last winter was as satisfactory as the two winters previous. Last winter five

lots of cattle were gotten through the winter in various ways. The first lot of steers was fed an average daily ration of 2 pounds of corn plus 10 pounds of hay; the second lot was fed an average daily ration of 15 pounds of corn silage plus 7 pounds of corn stover and straw; the third lot was fed an average daily ration of 15 pounds of corn silage plus 7 pounds of corn stover and straw; the fourth lot was fed nothing but winter pasture; the fifth lot was fed nothing but winter pasture. The winter period lasted 126 days, each steer in the first lot losing 35 pounds in weight, each steer in the second lot losing 52 pounds in weight, each steer in the third lot losing 76 pounds in weight, each steer in the fourth lot losing 18 pounds in weight, and each steer in the fifth lot losing nothing in weight. When corn is valued at \$1.00 a bushel, hay at \$15 a ton, corn silage at \$4.00 a ton, corn stover and wheat straw at \$10 a ton, and pasture at \$1.00 per steer for 28 days, it cost \$11.62 to feed each steer in the first lot all winter, \$7.63 in the second lot, \$7.91 in the third lot, \$4.50 in the fourth lot, and \$4.50 in the fifth lot. This pasture is nothing more than left over summer growth. That is, the stock is kept off of the ordinary pasture during the summer months. The grass is allowed to grow up and fall over and when the winter months come the animals are turned upon this summer growth and allowed to stay through the winter. This winter pasture is exciting favorable comments all through the mountain territory as many farmers realize now that these winter pastures afford the cheapest possible feed supply and at the same time give them an opportunity to enlarge the beef-growing capacity of their farms by providing extra feed in the winter time.

When summer pasture arrived these steers and yearlings were turned upon it and an account of their gains and weights and the cost of the gains and weights was kept until they were sold a few days ago. The steers in the first lot during the summer season of 140 days, gained 2.23 pounds; those in the second lot 2.5 pounds; those in the third lot 2.23 pounds; those in the fourth lot 2.38 pounds; and those in the fifth lot 2.48 pounds. The above gains were average daily gains. When pasture is charged at \$1.00 per head for each 28 days, it cost \$1.00 to make 100 pounds of increase in gain in the first lot; \$1.42 in the second lot; \$1.60 in the third lot; \$1.49 in the fourth lot; and \$1.43 in the fifth lot. When both the summer and winter feedings are taken into consideration, the cattle, therefore, which were on pasture all the time, both summer and winter, were raised very much more cheaply than those which were given other feed.

#### *Winter Feeding of Breeding Cows.*

(T. L. Gwyn, Haywood County.)

Mr. Gwyn is adding a breeding herd of Shorthorns to his cattle operations. This gives us an opportunity to add new phases to our investigational work. During the past winter the few breeding cows he has were divided into three lots and fed upon various rations. Each animal

in the first lot was fed daily 2 pounds of cracked corn, 2 pounds of cotton-seed cake, and 16 pounds of stover and straw; each cow in the second lot was fed 2 pounds of cracked corn, 3 pounds of cotton-seed cake, and 16 pounds of stover and straw; each cow in the third lot was fed 2 pounds of cracked corn, 3 pounds of cotton-seed cake, and 16 pounds of stover and straw. The animals used the past winter were too few to give conclusive results but when the expense of feeding them through the summer on pasture is added to the expense of getting through the winter, it is found that it cost from \$24.66 to \$27.51 to maintain each breeding animal a year. This is when corn is valued at \$1.00 a bushel, cotton-seed cake at \$35 a ton, stover and straw at \$10 a ton, and pasture at \$1.00 per head per month.

*Wintering Breeding Cows and Fattening Steers in the Coastal Plain.*

This work is being done upon the farm of Holderness and Shook at Tarboro. It is not possible, however, at the present time, to give anything except an outline of what is being done as the work has not gone far enough for a summary. A large herd of Aberdeen-Angus breeding cows and heifers and calves is involved in the work. The main object in working with the fifty breeding cows is to determine the effect of heavy and light feeding upon the cows and their offspring. The main object in working with the 21 breeding heifers is to determine the cost and best method of wintering in the coastal section. The main object with the 30 young calves is to determine the effect of heavy and light feeding upon the growth and maturity. By next year definite results will begin to come from this work.

*Wintering Steers on Corn Silage.*

(Iredell Branch Station Farm.)

During the winter of 1916-'17 32 high grade steers belonging to Mr. Eugene Transou of Stratford, were borrowed for use at the Iredell Branch Station Farm for the purpose of keeping accurate records of the cost of wintering beef steers. In addition to this a study was to be made of their grazing qualities during the succeeding summer. When the cattle arrived at the farm, January 13, 1917, they were divided into two lots. In the first lot the steers were each fed daily 15 pounds of corn silage, 10 pounds of corn stover, and 1 pound of cotton-seed meal; each steer in the second lot was fed daily 25 pounds of corn silage, and 1 pound of cotton-seed meal. Due to the fact that the supply of corn silage was exhausted too early it became necessary to incorporate other feeds in the ration during the last part of the experiment. From January 13, 1917, to April 24, 1917, when the experiment closed, it cost \$10.14 to feed each steer in the first lot and \$10.29 in the second lot. This is when cotton-seed meal is valued at \$42.50 per ton, corn silage at \$4

a ton, corn stover at \$8 a ton, cotton-seed hulls at \$20 a ton, and straw at \$10 a ton. The steers in the first lot gained daily .42 of a pound while those in the second lot gained daily .39 of a pound. These results show very economical methods of wintering especially when the value of the manure is included in the statement. A total of 35.5 tons of manure was produced which, at present prices of fertilizers, is worth about \$5.50 a ton.

This work, like the previous tests, shows that when cattle are being wintered they usually do better if some dry feed is incorporated with the corn silage. The cattle which were receiving silage alone were losing weight until corn stover was added, then they began to increase in weight rapidly.

### *The Value of Peanut Meal for Fattening Beef Cattle.*

(Edgecombe Branch Station Farm.)

The excessive high prices of feeds have brought into prominence another new feed, namely, peanut meal. A large number of the cotton oil mills are manufacturing this meal and it has come to be one of our important commercial feeds. In our investigational work, we have established its economical place with poultry and swine but nothing, until recently, had been done in feeding it to beef cattle. In order to determine its feeding value for beef cattle, a test was inaugurated on the Edgecombe Branch Station Farm last winter. The experiment started January 10, 1917, and concluded on May 9 of the same year. Twenty-four cattle divided into two lots were employed. Those in the first lot were given peanut meal and corn silage; those in the second lot were given peanut meal, corn silage, and corn stover. When they were on full feed, the cattle in the first lot ate daily 9 pounds of peanut meal and 25 pounds of corn silage, while those in the second lot ate 9 pounds of peanut meal, 15 pounds of corn silage, and 10 pounds of corn stover. All of the cattle made satisfactory gains. Those in the first lot increased in weight daily 2.05 pounds, while those in the second lot gained daily 1.83 pounds. When the cattle were sold they were in good condition. The results of the test show that peanut meal is an excellent feed for fattening beef cattle. They cost 7 cents a pound in the mountains, and were sold, when fat, for 9½c a pound on the farm. When peanut meal is valued at \$35 a ton, corn silage at \$4 a ton, and corn stover at \$8 a ton, some money was made on the animals. In fact, \$71.26, therefore, was realized when the manure is not included. When the interest on the money borrowed and the labor were charged against the cattle, the manure is left as a clear profit.



## SHEEP.

*Sheep Investigational Work.*

Sheep Investigational work is being conducted at the Central Branch Station Farm at Raleigh, the Iredell Branch Station Farm, and in Mitchell County. Not very extensive investigational work is under way at present. This weakness, however, will be remedied by another year as the work in Mitchell County will be developed rapidly.

In a general way the projects given the last year's report are being continued. These projects are:

1. *Sheep Breeding Work.*—The sheep breeding work is divided into two parts. In the first place Shropshire and Rambouillet rams have been mated with Barbado ewes to determine whether or not the Barbado blood renders our sheep in any degree immune to stomach worms and also to determine the effect of the introduction of Barbado blood on the season of breeding. It is claimed by some authorities that Barbado sheep do not succumb to the ravages of the stomach worm. Our work has not gone far enough yet to be conclusive on that point but we have no indication, so far, that this belief is true. It is also claimed by some that Barbado ewes breed at any season of the year. Our native ewes, of course, will not receive the attention of the ram except at stated seasons. This means that the lamb crop very often comes at unfavorable times. This phase of the work has not gone far enough to determine just what influence the trace of Barbado blood has upon the season of breeding although we do know that the pure bred Barbado ewes breed almost any month in the year.

The original Barbado ewes have been disposed of as their period of usefulness was passed but a number of half-bred and three-quarter-bred Shropshire-Barbado and Ramboillet-Barbado ewes have been saved for continuing the work.

In the second place these same breeding animals are being used in the experiment to determine the effect of different rations of cotton-seed meal upon the health and reproductive organs. It is claimed by many that heavy and continuous feeding of cotton-seed meal affects the breeding qualities of the breeding animals. At the present time no detrimental effects have been noticed although the work has not been going long enough to make our observations conclusive.

2. *Stomach Worm Experiments.*—The work conducted this year is a duplication of that given in my last report. This work is being pursued at the Central Station Farm and also at the Iredell Branch Station Farm, the object being to determine the effect of low, medium, and high conditions in the sheep in retarding the ravages of stomach worms. The lambs employed were divided into three lots. The first lot was gotten through the summer on pasture alone; the second lot on pasture plus one-half a pound of grain per lamb per day; the third lot upon pasture

plus one pound of grain per lamb per day. The results so far indicate that the infested pasture, with a medium ration of grain, is not sufficient to retard the detrimental effects of stomach worms in lambs. The lamb during his first summer is an exceedingly delicate animal and when placed upon pastures which are heavily infested with stomach worms, his chances of coming through the summer alive are very small unless he is fed a partial ration of grain to sustain his strength. At the Iredell Branch Station Farm, where one pound of grain was fed daily, only one lamb out of ten was lost. The small amount of grain no doubt saved the lives of the other nine. This problem is important only with lambs which are to be carried through the first summer for breeding purposes as lambs which are to be placed upon the market should be finished and sold before the season for stomach worms comes on.

3. *Winter Feeding of Ewes on the Iredell Branch Station Farm.*—During the winter of 1916-'17, 20 grade Shropshire and Rambouillet yearlings ewes were fed on the Iredell Branch Station Farm to determine the effect of different methods of wintering ewes. The ewes were divided into two lots, the ewes in the first lot being fed daily one-half a pound of grain and given the run of a good pasture during the day when the weather was fit; each ewe in the second lot was fed a similar amount of grain plus corn silage and kept up in a dry lot all the winter. The experiment continued from November 4, 1916, to March 26, 1917, a period of 142 days. When cracked corn is valued at \$44 a ton, cottonseed meal at \$40 a ton, wheat bran at \$42 a ton, corn silage at \$4 a ton and hay at \$20 a ton, it cost \$2.98 to get each ewe in the first lot (winter pasture lot), through the winter, and \$3.75 to get each ewe in the second lot (dry lot), through the winter. At the same time the ewes which had the run of the winter pasture lost less in weight than did those which were confined in the dry lot and fed grain and corn silage. The ewes, of course, during the latter part of the winter had suckling lambs.

#### DAIRY CATTLE.

##### *Dairy Experimental Work.*

In the past three years, Mr. Eaton has conducted investigational work with dairy animals and dairy problems upon the Central Station Farm at Raleigh, the Pender Branch Station Farm, and in coöperation with some farmers in the Greensboro territory. The work being done by Mr. Eaton is used as a basis for teaching by the extension workers. As I have stated in previous reports, extension workers of the State who are leading the people along dairy lines, are very frequently embarrassed by the lack of accurate information. Southern institutions, so far, have done very little work along dairy lines, and for this reason it is harder for the dairy extension people, including those working in household economics as well, to be safe leaders than it is for extension workers in almost any other phase of live stock production. In a general way,

Mr. Eaton has been investigating feeding problems, growing problems, manufacturing problems, including those relating to the making of home cheeses. The scope of his work may be generally appreciated after reading the following results of his efforts:

*Onion Contamination.*

(Pender Branch Station Farm.)

One of the very greatest drawbacks to the dairy interests in the South, especially in Piedmont sections, is the presence of onion flavors in milk, cream and butter. In fact, onions grow so luxuriantly in some parts of the State that they are really the limiting factor so far as dairying is concerned. Mr. Eaton is continuing his study and trying to determine some practical and economical way of eliminating onion flavors. While he has not been satisfied with the results, still, he has made more progress than any one else in the country on this particular question. So far, he has used twelve Jersey and Holstein cows in his work and has studied over 6,000 samples of milk. It would be out of place for me, in this report, to review just how he has attacked the problems. As a result of his studies, he is warranted in making the following conclusions:

1. It is possible to remove the flavor on a commercial scale by blowing a current of heated air through the milk for a length of time dependent upon the degree of flavor.

2. Molasses feeds have a tendency to slightly weaken the flavor.

3. Onion flavor becomes more pronounced as the acidity of the milk increases.

4. A slight onion flavor has been found in two per cent of the milk samples twenty minutes after onions were eaten; the climax of the flavor is reached in from two to two and a half hours, and the flavor naturally disappears in four to four and a half hours, provided the cow does not eat more than three or four pounds of onion tops. Only two per cent of the samples have been found to show a slight flavor at five hours after onion tops were eaten.

As a safeguard against trouble from the fall crop of wild onions which will be on in a few weeks, the following suggestions may be found helpful:

Let dry cows and calves have the run of the onion pastures where possible.

Feed the cows heavily on molasses feeds or mix a liberal amount of feed molasses with your present grain mixture.

Remove the herd from onion pasture from to five hours before milking; this may slightly decrease your milk flow, but will improve the quality of your product if onions are present.

*Winter Rations for Dairy Heifers.*

(Pender Branch Station Farm.)

This is a continuation of the experiment inaugurated at the Pender Branch Station Farm in 1913, the object being to study the value of cotton-seed meal, as compared with wheat bran, when used in a ration for growing dairy heifers. This experiment the last winter continued from October 1 to April 1. The first lot of calves was fed a ration made up of bran and cotton-seed meal, half and half, plus corn stover; the second lot of heifers was fed a ration of cotton-seed meal alone plus corn stover. The calves in the first lot were allowed to fall off 25 pounds each during the winter months, while those in the second lot fell off 54 pounds each. The past winter, therefore, the replacement of half the ration of cotton-seed meal with wheat bran had a favorable effect upon the weights secured in the animals' feed. Corn stover is, of course, an exceedingly poor roughage for calves of this age but no other roughage was available. When wheat bran is valued at \$35 a ton, cotton-seed meal at \$40 a ton, and corn stover at \$10 a ton, it cost \$7.32 to feed each calf in the first lot (wheat bran and cotton-seed meal), through the winter months, and \$7.55 to feed each calf in the second lot.

*Spring and Summer Rations for Dairy Heifers.*

(Pender Branch Station Farm.)

The heifers used in the winter work were carried into the spring and summer work to determine the value of the same grain rations when fed in conjunction with spring pastures. On April 1, 1917, the first lot of heifers, which was fed a ration of cotton-seed meal and bran half and half, was turned upon a rye pasture; the second lot of heifers, which had cotton-seed meal alone, was also turned upon the same pasture. They were upon this pasture for 61 days, each calf receiving daily during this time, one pound of grain and  $1\frac{1}{2}$  pounds of corn stover. During this time, the calves which had some wheat bran gained very much more rapidly than did those fed upon cotton-seed meal alone, as each calf, during the 61 days, in the bran-lot gained 96 pounds, while those in the cotton-seed-meal-lot gained only one-third of a pound.

*Cracked Corn Versus Beet Pulp for Dairy Heifers.*

(Central Station Farm.)

It is often claimed that beet pulp is a substitute, or at least a partial substitute, for pastures. It is also often claimed that calves fed upon beet pulp grow very much more satisfactorily than those fed upon a ration that does not contain beet pulp. If beet pulp will, in a measure, take the place of pasture it is an important thing for many Southern



farmers to know until pastures can be developed, but Mr. Eaton so far does not indicate that it has this virtue. A bunch of heifers was divided into two lots. The first lot was fed a ration made up of three parts cracked corn, one part cotton-seed meal, one part wheat bran, and hay and corn stover; the second lot was fed a ration made up of three parts beet pulp, one part cotton-seed meal, one part wheat bran and an equal amount of hay and corn stover. The experiment continued from May 1, 1916, to January 7, 1917. The calves eating the beet pulp did not make any more satisfactory gains than did those eating cracked corn. In fact, during this time they made practically the same daily gains as those in the first lot gained daily 1.16 pounds, while those in the second (beet pulp), gained 1.13 pounds. At the present time the cost of feeding the calves is just about the same.

### *Cost of Raising Calves.*

(Pender Branch Station Farm.)

This is one of the old projects at the Pender Branch Station Farm. During the past year accurate records have been kept upon fifteen calves from birth to the age of six months. When grains are valued at \$55 a ton, mixed hay at \$20 a ton, silage at \$4 a ton, stover at \$10 a ton, whole milk at \$2.50 per hundredweight, and skim milk at 50 cents per hundredweight, it has cost \$8.18 to feed each calf until he is three months old, and \$15.87 to feed each one until he is six months old.

### *Coöperative Calf Raising.*

(Greensboro Neighborhood.)

This work, as given in my last report, was inaugurated two years ago with about fifteen farmers in the general neighborhood of Greensboro to determine the cost of raising dairy calves under practical farm conditions. This work was terminated August 31, 1917. Mr. Eaton has not as yet had time to summarize the results but will soon get them together and give them to the public.

### *Cooling Convenience for the Farm Home.*

One of the most difficult home problems where cream is produced for the market is to keep the cream satisfactorily after it is produced. The authorities of several creameries of the State have requested us to study the problem of keeping cream in the home and try to develop some satisfactory inexpensive farm device for cooling it. Mr. Eaton did the first year's work in coöperation with 28 patrons of the Mooresville Co-operative Creamery in August and September of this year. He first studied the efficiency of a barrel cooler. Half of the above farmers were supplied with barrels and shotgun cans for holding the cream. These

barrels were connected between the wells and watering troughs and the arrangement was fixed so that when fresh water was drawn for the farm stock it would flow through and change the water in which the cream cans were kept. The cream from these two classes of patrons was churned separately and the butter scored by three judges. The experiment shows a remarkable reduction in the bacterial count in favor of the cooled cream, but the three judges did not make much difference in the score of the butter produced from the two classes of cream. On account of the fact that September was an unusually cool month the barrel cooler did not have a fair show. During this month there was only 47 per cent of sunshine and the average daily temperature was 3.1 degrees below normal. The experiment will, of course, be continued next summer.

Mr. Eaton also made a study of the efficiency of iceless refrigerators for a period of eight weeks during the summer of 1917. In the first year's work the results seem to indicate that iceless refrigerators have practically no value as there was only an average difference of 1.5 degrees between the average temperature of three of these refrigerators and the average mean atmospheric temperature. The average mean temperature during August and September, 1917, the time when the experiment was conducted, was 71.8 degrees, while the refrigerator temperatures were on the average only 1.5 degrees cooler.

#### HORSES AND MULES.

It is unfortunate that an appropriation has not been made to secure a competent man to look after the horse and mule work of the State. I hope that finances may soon become so a strong man can be secured and placed in charge of this work. So far, I with the assistance of Mr. Hostetler, have been doing what little work is being done with horses and mules. We really have only one project and this is being studied at the Iredell Branch Station Farm, Edgecombe Branch Station Farm, and Pender Branch Station Farm. All of the feeding work with horses and mules hinges around the question of the place of cotton-seed meal in the work animal's ration.

This piece of investigational work is not nearly completed; in fact, it is only really begun but still some valuable and definite facts have come to the surface. The results secured can be illustrated by calling attention briefly to the experiment upon the Edgecombe Branch Station Farm. Upon this farm six mules labor constantly at ordinary farm work. Three of these animals, since February 1, 1915, have had corn alone as the grain part of the ration. The kind of hay used has varied from time to time, but has consisted of corn stover, cowpea, crabgrass, Sudan and soybean hay. The other three mules—teammates of the first three—have, during all this time, had, in addition to the corn, small daily amounts of cotton-seed meal. The allowance, at first, was small as each mule now eats only one pound of cotton-seed meal daily. As a rule,

the corn was fed on the ear, the cotton-seed meal being sprinkled upon the ears. The following table gives a brief outline of the results obtained the first 29 months:

| Lot. | Ration.          | Grain Eaten             | Annual Cost               | Average No.                                | Average Loss             |
|------|------------------|-------------------------|---------------------------|--------------------------------------------|--------------------------|
|      |                  | Yearly by<br>Each Mule. | of Grain<br>for Each Mule | Hrs. Worked<br>Each Month<br>by Each Mule. | in Weight<br>for 29 Mos. |
| 1    | Corn             | 69.9 bu.                |                           |                                            |                          |
|      | Roughage         |                         | \$139.20                  | 158                                        | 50 lbs.                  |
| 2    | Corn             | 61.6 bu.                |                           |                                            |                          |
|      | Cotton-seed meal | 296 lbs.                | 130.60                    | 149                                        | 40 lbs.                  |
|      | Similar roughage |                         |                           |                                            |                          |

The table shows, when corn is valued at \$2 a bushel, and cotton-seed meal at \$50 a ton, that the small amount of cotton-seed meal cheapened the ration for each mule, \$8.60 annually. When the amount of cotton-seed meal is increased and the amount of corn correspondingly decreased, and this is to be done soon—the annual saving will be still greater. During all this time the mules did almost equal amounts of work as measured in number of hours. Each mule in the corn-fed lot worked, on the average, 158 hours each month, while each one in the cotton-seed-meal lot worked 149 hours. All of the mules are in good health and have almost maintained constant weights. It is noticeable each spring, however, that the animals which have the small allowance of cotton-seed meal “shed off” earlier and more uniformly than do those eating corn as the sole concentrate.

Almost exactly similar results have been secured at the Iredell Branch Station Farm and at the Pender Branch Station Farm. When the results at Edgecombe are studied it is seen that one ton of cotton-seed meal saved 56 bushels of corn. In the Statesville work one ton of cotton-seed meal saved 11.2 bushels of corn plus 10.17 bushels of oats. At the Pender Branch Station Farm one ton of cotton-seed meal saved 34.4 bushels of corn.

#### POULTRY INVESTIGATIONAL WORK.

Dr. Kaupp, who has charge of the investigational work with poultry, is doing his work at the Central Station Farm, Pender Branch Station Farm, Edgecombe Branch Station Farm and Iredell Branch Station Farm. I cannot begin to give, in a report of this character, anything more than an outline of the work which Dr. Kaupp is doing. The only thing I will try to give is the results of some of his most characteristic pieces of investigation. In a general way, however, his efforts are directed along four general lines. In the first place he does a little extension work in the way of lectures, farmers' institute work, and displays at fairs. In the second place, he devotes much time to laboratory investigations which have to do directly or primarily with the questions

relating to diseases of poultry. In the third place, he devotes much of his time to carrying on the practical and scientific experiments upon the Central Station Farm at Raleigh. In the fourth place, he devotes some of his time to keeping in touch with the poultry work on the three Branch Station Farms mentioned above.

### *Raising Chickens on Peanut Meal.*

(Edgecombe Branch Station Farm.)

Peanut meal has proven to be an exceedingly palatable and practical feed to use in conjunction with other feeds suitable for raising chickens. Last spring a flock of chickens came off the nest April 8 and were fed a ration made up of equal parts of peanut meal, ground oats, and cornmeal. These grains were mixed with buttermilk. At the end of eight weeks the chickens averaged 1.3 pounds each in weight. This was entirely satisfactory. The second flock was started on the same date and at the end of eight weeks each one of them weighed 1.2 pounds. A third flock came off April 13 and was handled in the same manner and fed in the same way. At the end of eight weeks the chickens in this flock averaged 1.4 pounds each in weight. In all a total of 27 test lots on this farm have been fed under farm conditions and the above three examples give a fair idea of the results. That is, peanut meal has a place as a feed for chickens.

### *Value of Milk in Raising Chickens.*

(Iredell Branch Station Farm.)

At the Iredell Branch Station Farm something over 34 individual experiments have been run the last two or three years to determine the results when little chickens are raised without milk of any kind as compared with other chickens which are raised with skim milk. Two or three illustrations will indicate the results secured. For instance, one lot of chickens was hatched February 2. They were fed rolled oats, cornmeal, and wheat bran, the chickens receiving only water to drink. During the last four weeks of the test they were given a grain mixture in addition to the wet mash of wheat, oats, and cracked corn, equal parts. At the end of eight weeks these chicks averaged only .2 of a pound each in weight. They were attacked by diarrhea which caused a high death rate and interfered with development. On the other hand similar chicks run in parallel tests at the Pender and Edgecombe Branch Station Farms, except that the chickens on the last two farms were given milk to drink, were not attacked by diarrhea and weighed six times as much. A second lot of chickens at the Iredell Branch Station Farm came off the nest February 21 and were fed in exactly the same manner. At the age of eight weeks each chicken averaged only one-fourth of a pound in weight. On March 11 a third



lot of chickens was placed in the experiment and were given the same treatment and feed. At the end of eight weeks these chicks averaged .22 of a pound each in weight. During all this time check lots were run upon the other two test farms where milk was used and the chickens were from five to six times as large as those where buttermilk was not used.

*Soybean Meal for Little Chicks.*

(Edgecombe Branch Station Farm.)

As stated above it has been shown at the Edgecombe Branch Station Farm that peanut meal is an excellent feed for raising little chicks. Soybean meal is another new feed upon our markets and many inquiries are coming to Dr. Kaupp relative to its value as a chicken feed. To determine this point he has been doing some work at the Edgecombe Branch Station Farm in raising little chicks on a ration made up of soybean meal, wheat shorts, and corn meal, in equal parts, and mixed with sweet milk. One lot of chicks averaged 1.4 pounds in weight when eight weeks old. A second lot handled and fed exactly as the first, except that rolled oats was used in place of soybean meal, averaged 1.1 pounds in weight at the same age. On April 15 another bunch of chicks was placed on a soybean meal ration and at the end of eight weeks averaged 1.3 pounds in weight. A fourth lot, hatched April 22, was fed upon a similar ration and averaged 1.6 pounds at the age of eight weeks. Still another lot was fed in the same way and averaged 1.5 pounds when eight weeks old. In all sixteen lots of chickens have been fed as indicated above and the results have always been satisfactory so we have no hesitancy in recommending soybean meal as a good ration for feeding little chicks.

*Feeding Laying Hens in Dry Lots as Compared With Range Conditions.*

(Pender Branch Station Farm.)

This kind of work is being done at both the Pender and Iredell Branch Station Farms. In this study an accurate account is kept of everything that happens such as the amount of feeds fed, number of eggs laid, the strength of the chickens hatched, the diseases that appear, and the amount of sickness in the two lots. The results last year showed that the lot of Buff Rock hens, 32 in number, in the range lot laid 2,651 eggs. The same number of hens shut up a dry lot and fed the same ration as that fed in the range lot, laid only 314 eggs. These hens all had good treatment and good feed, the only difference being that one lot of hens had the run of the farm thus getting green feeds, bugs, and worms while the other one was enclosed in a dry lot and got none of these supplements.

This work is of particular interest to the town or city man who expects to keep birds shut up in close quarters.

*The Control of Mites.*

Dr. Kaupp has found that dry air-slaked lime, dry flowers of sulphur, and dry tobacco stems and leaves will not kill mites. These things are sold extensively. If the mites are killed the sulphur must be in solution and the nicotine in the tobacco must be free from the stems and leaves. When this nicotine is properly prepared it is effective. To properly prepare it  $2\frac{1}{2}$  pounds of stems and leaves should be put in sufficient water to cover it, boiled for one hour, the liquid drained off, and boiled down to one-fourth of a pint, this mixed with four ounces of water in which there has been put one tablespoonful of nicotine with one quart measure of plaster of Paris. This should be stirred, passed through a fly-screen sieve, when it is ready for use. Dr. Kaupp has worked out this formula and found it to be effective.

*Laboratory Work.*

Dr. Kaupp is a pathologist and he was brought here to devote much time to the study of diseases of all kinds of poultry. He has, consequently, devoted much time to laboratory studies particularly those phases which relate to diseases and pathological conditions. During the past year he has continued the study of the anatomy, histology, and physiology of the hen. As material presents itself he has also continued the study of tumors, roup, limberneck, and various kinds of poultry infections. In addition to this, he is doing some very original work in determining the digestive coefficient of feeds for fowls, a thing that has never been determined by investigators so far. His laboratory has been very useful in the milk sickness problem that Messrs. Curtis, Wolf and Kaupp are studying, as Dr. Kaupp handles the pathological phases of that study.

Practically every one has noticed that fowls of all kinds are resistant to the usual pus-producing organisms. That is, it is a very seldom thing to find fowls of any kind carrying old sores of any sort. All other animals, including humans, are very susceptible to pus organisms which produce sores. Dr. Kaupp is spending much time trying to determine just why the fowl is resistant to this sort of trouble. If this can be determined it is very easy to see just how the application may be made in other animals and in humans, and prove to be a valuable piece of information.

*Feeding Cottonseed Meal to Laying Hens.*

(Central Station Farm.)

Last year I reported that a long-time experiment had been outlined with poultry to determine what effect cottonseed meal may have upon hens when fed for long periods of time. The first part of this work has been under way for two years. One pen of hens receives a ration made

up of 30 per cent of cottonseed meal; a second lot receives a ration made up of cottonseed meal 5 per cent; a third lot of hens receives a ration consisting of no cottonseed meal at all. Up to date, or at the end of the second year, 17 hens have died in the pen where the high portion of cottonseed meal has been fed, 17 in the pen where the low portion of cottonseed meal was fed, and 10 in the lot where no cottonseed meal was fed at all. These are high percentages as only 50 hens were used in each lot.

A second series of cottonseed meal experiments was started November 1, 1916. All of the birds used were hatched from our eggs during the spring of 1916. The first pen is receiving a ration made up of 1 per cent cottonseed meal; the second pen of hens is receiving a mash made up of cottonseed meal 5 per cent; the third pen is receiving a mash made up of 10 per cent. This series has not gone far enough to warrant any conclusions but up to date the death rate has been unusually high. In fact, not any of our work where cottonseed meal has been fed to poultry has been satisfactory, provided heavy amounts of cottonseed meal were used.

In a third series of experiments where cottonseed meal was fed to hens, the object was to make the other part of the ration so palatable and complete that the bad effects of cottonseed meal would not appear. powder 20 per cent, and ground corn 40 per cent; the second lot of hens received a ration made up of cottonseed meal 40 per cent, whole milk powder 20 per cent, and ground corn 40 per cent; the second lot of hens received a ration made up of cottonseed meal 30 per cent, meat meal 10 per cent, ground corn 30 per cent, wheat bran 10 per cent, ground oats 10 per cent, and skim milk 10 per cent; a third lot of hens received a ration made up of cottonseed meal 30 per cent, wheat bran 20 per cent, ground oats 20 per cent, and ground corn 30 per cent; the fourth lot of hens received a ration made up of cottonseed kernels 40 per cent, whole milk powder 20 per cent, and ground corn 40 per cent; the fifth lot of hens received a ration made up of gossypol (gossypol is the poison found in cottonseed meal), two-tenths of 1 per cent, wheat bran 30 per cent, ground oats 19.8 per cent, ground corn 20 per cent, meat meal 20 per cent, and whole milk powder 10 per cent. The experiment started December 1, 1916, and terminated May 21, 1917. The hens in lots 5 and 6 suffered with pendulous crops, becoming sick as a result of eating the cottonseed meal and all in lots 5 and all in lot 6 probably would have died if the feed had not been changed. At the end of the test all of the hens in the first lot were in good physical condition except one which was suffering with pendulous crop. All of the hens in the second and third lots came through in good condition. This preliminary study, therefore, gives us a basis for continuing more extensive work as some combinations of feeds with cottonseed meal promise some hope of overcoming the usual ill results when cottonseed meal is employed.

*Breeding Work With Chickens.*

(Central Station Farm.)

All the careful breeding work is being done at the Central Test Farm as this work requires almost hourly supervision by Dr. Kaupp or some of his assistants. Many breeds of chickens are being now used in this work. We now have Silver Campines, Silver Spangled Hamburgs, Dark Cornish, Silver Penciled Wyandottes, Golden Wyandottes, Columbian Wyandottes, Buff Plymouth Rocks, White Plymouth Rocks, Buff Orpingtons, White-Faced Black Spanish, Mottled Houdans, Black Cochin Bantams, Barred Plymouth Rocks, Single Comb White Leghorns, and Single Comb Rhode Island Reds. All of these breeds of chickens are used in some phase of breeding work. The biggest breeding problem we have is to develop a flock of White Leghorns which will produce more eggs than flocks already owned by farmers of the State, the object being, of course, to finally sell the eggs throughout the State. Complete records are kept of all these breeds as the number of eggs produced, number of infertile eggs, number of dead, chickens hatched, and the per cent of chickens raised. The main breeding problems are:

(a) A study of the fertility and ability to hatch of eggs resulting from single services by the males and by the alternation of the use of males.

(b) The result of the introduction of new males into breeding flocks.

(c) The result of mating daughters with fathers.

(d) The fertility and ability to hatch of white against brown shelled eggs.

(e) The breeding up of all of these flocks into better individuals and into greater egg producers.

Some of the above studies have gone far enough to draw some tentative conclusions. So far, the eggs with the white shells are more fertile than those with brown shells. During the year 1916 the white-shelled eggs were 8.7 per cent more fertile than the brown-shelled ones. And, in 1917 the white-shelled eggs had an advantage of 14.7 per cent. In the breeding work where the daughters have been mated to fathers, the result invariably showed a decrease in fertility from two to five per cent. When this sort of mating is allowed the number of chickens hatched from fertile eggs is also lower; in our work from 10 to 30 per cent. In that part of the breeding work where we have been noting the effect of introducing new males, we have seen that it is not always profitable especially if the new male has been inbred. In some of our work where the males have been allowed to be with the female only a few hours during the day the fertility was increased very materially, but in some other work the fertility of the resulting eggs was not perceptibly affected. The number of hens which each male is allowed to mate with has probably more to do with this than the number of hours he is with the hens each day.



It is necessary, of course, to continue the breeding studies over many years to get the desired results and reliable information.

*The Effect of Mineral Matter Upon the Development of Young Chicks.*

The most difficult period of the life of chickens is the first 48 weeks. The farmer or housewife who can manage to get chickens through this period feels that his greatest trouble is over as so many diseases attack the chicks at this young age and so many conditions cause them to develop unsatisfactorily. Many people are under the impression that one of the reasons why so many chicks are diseased and undeveloped is because they do not get a sufficient amount of the right kind of mineral matter in their foods. To study this question thoroughly and also to determine just what effect various mineral matters have upon the bodies of the young chicks, Dr. Kaupp has begun a careful piece of investigation. The first year's results are at hand except chemical analyses which are being determined at the present time.

All of the feeds used are analyzed as well as the bodies of the chickens after they are grown upon various rations. One lot of chickens is raised on a ration made up of rolled oats, wheat middlings, meat and bone meal, a second lot is raised on a ration made up of cracked wheat, cracked corn, and pinhead oats; a third lot is raised on a ration made up of wheat middlings, corn meal, meat and bone meal; the fourth lot is fed on a ration made up of whole wheat (not milling wheat), cracked corn and hulled oats. In addition to these rations some of them are fed an extra amount of chemically pure minerals, these being mixed with the feed. About all that can be said, so far, without having the chemical work before us is that the minerals have not had as much effect on the growth of the chickens as would be expected.

*Shipping Fat Poultry to the Market.*

As time goes on there will develop in this State, no doubt, very heavy fattening and shipping interests. In some states the question of fattening and shipping hens is a big one, and with hens, as with other stock, it is important to know how they should be fed just previous to being shipped to insure small shrinkage in weight. One lot of broilers was fattened for 21 days on a ration of buttermilk and mash and then shipped to New York City. The shrinkage in weight was 11.3 per cent; a second lot of hens was fattened on cornmeal, wheat middlings, ground oats, and buttermilk for 10 days and shipped to New York City. They shrank in weight 5.3 per cent. These birds, just before being started from Raleigh were each one given four ounces of whole corn and all the water they cared to drink. It seems, therefore, that the feeding of corn just before starting them on the trip reduced very materially the percent of shrinkage. In a third experiment to determine the percentage of shrinkage some fat hens which had been fed upon mash and

buttermilk were shipped to New York City. These hens were also, just before being started from Raleigh, fed upon some whole corn and the average shrinkage was only 2.6 per cent. Many other shipments have been made with about the same results.

*The Use of Milk in the Ration for Little Chicks.*

(Iredell Branch Station Farm.)

During the year of 1915-'16 the chick work conducted at the Iredell Branch Station Farm was for the purpose of determining the influence of ordinary farm practices and farm feeding upon the development of chicks. The same feeds and methods of feeding were employed as have been in vogue on the farm during previous years but an accurate account was kept of all of the feeds eaten and the size of the chicks. During these two years the chicks were almost always attacked with diarrhea, the mortality was high, and the average weights at the end of the eighth week ran from .2 to .3 of a pound each. Last spring new rations were introduced and some lots were fed a limited amount of milk. The chicks which received a limited amount of buttermilk in addition to a good grain ration, averaged 1.3 pounds in weight at eight weeks of age, while those which were given water in place of the buttermilk with the same kind and amount of grain, averaged 1.1 pounds in weight at the same age. The buttermilk was, therefore very efficient.

In another set of experiments upon this test farm where buttermilk was used in conjunction with dry grains, chickens averaged 1.44 pounds in weight at the age of eight weeks. The water-lot of chickens averaged 1.32 pounds in weight. In a third test the buttermilk-fed chickens averaged at eight weeks of age 1.55 pounds, while those which were raised without buttermilk averaged 1.5 pounds in weight. In still another series of tests the chickens raised upon buttermilk averaged 1.5 pounds in weight at the age of eight weeks, while those which were raised upon water averaged 1.15 pounds in weight. In still another series of experiments the water-fed chicks at the age of eight weeks, averaged 1.13 pounds in weight against 1.43 pounds in weight, 1.36 pounds and 1.39 pounds in weight in the three lots where buttermilk was used to supplement the grains.

Many other similar experiments were made during the year at the Iredell Branch Station farm but the above results give just about the average of the results secured.

*Raising Chicks on Soybean Meal and Buttermilk.*

(Pender Branch Station farm.)

Dr. Kaupp has been doing considerable work at the Pender Branch Station Farm in determining the value of soybean meal in raising chicks when fed along with ground oats, corn meal in equal parts. The re-

sults below shows that he has proven soybean meal to be a valuable feed in this mixture.

In one test where this grain mixture was fed along with buttermilk the chickens at the age of eight weeks averaged 1.2 pounds in weight, while similar chicks in the second lot, receiving the same grain ration but water in place of buttermilk, averaged only .88 of a pound in weight.

In another series of experiments chickens which were raised upon the same grain mixture and buttermilk averaged 1.3 pounds in weight at the end of eight weeks, while those which were raised upon the same grain mixture but had water in place of buttermilk, averaged only .75 of a pound in weight. In still another series of experiments the chickens which were raised upon soybean meal mixture plus buttermilk averaged 1.13 pounds in weight at the end of eight weeks, while those which had the same grain mixture but water in place of the milk, averaged only .76 of a pound in weight.

Much more work of this character has been done at the Pender Branch Station Farm but the results given above are fair averages of the whole work which show that soybean meal is not only a valuable feed for raising small chickens but that buttermilk is remarkably efficient when compared with water.

Respectfully submitted,

DAN T. GRAY,  
*Chief, Animal Industry Division.*

## REPORT OF DIVISION OF ENTOMOLOGY.

*To the Director:*

I herewith present report on the Entomological projects of Investigation under my charge, covering the period June 30, 1916 to June, 1917, inclusive.

1. *Pecan Insects*.—This project has been handled for several years by Mr. R. W. Leiby, Assistant Entomologist. Additional data on the life-history of many insect enemies of the pecan has been secured, covering points that must be considered in applying remedies for their control. As the study proceeds, its economic importance becomes more apparent. Thus in the early summer of 1917, many pecan trees were seriously injured or endangered by the attacks of the Pecan Leaf Case-bearer. A few years ago we would not have known how to deal with such an outbreak, but as the studies of Mr. Leiby had already revealed the essential points in its life-history, he was prepared to specify the manner and time to apply remedies for it, and his tests gave satisfactory control.

This is a good illustration of what I conceive to be the true function of investigations of this character. Here was a crop which at the time these studies began was of minor importance with only a few known serious insect enemies in this State. Studies were made upon this case-bearer when it was not known to our growers as a serious pest, and as a consequence of these studies remedies could be applied as soon as it did assume importance.

2. *Corn Stalk-borer*.—This project also has been conducted by Mr. Leiby during the past year, with very little participation on my own part. The observations have been made chiefly at the Coastal Plain Station (Edgecombe County). Additional and more definite data has been secured, which as the study covers a longer period will permit a more accurate averaging of results.

3. *Potato Spraying*.—The disastrous floods of 1916 rendered the results of the work of that year at the Mountain Station (Buncombe County) of little value. During the time covered by this report, the work of 1917 has been under way. It may be added that as this is being written (after the period covered by this report) the data from the work of 1917 has been secured, and is highly satisfactory. Already the work has gone far enough to furnish a safe basis for some extension propaganda for the spraying of potatoes, and extension circular No. 48 on "Spraying Irish Potatoes" was issued and widely distributed in the spring of 1917.

4. *Peach Spraying*.—The work done on this project by Mr. S. C. Clapp and myself at the Piedmont Station (Iredell County), was suspended after the season of 1915 for a variety of reasons—late frost and early drought curtailed the crop of 1916, while the resignation of Mr. Clapp to take charge of the Mountain Station, and the increased



office duties assumed by myself upon the entry of this country into the war, prevented its continuance in 1917. Furthermore, most of the points which we had in mind were well answered by the years of 1914-15. (1) We found that the commercial lime-sulphur at 1 gallon to 49 gallons of water with arsenate of lead added, when persistently used as a summer spray would result in final injury to the trees, although this was not evident the first year and did give better color to the fruit than the standard self-boiled lime-sulphur with arsenate. (2) The counts of premature "drops" indicated a greater percentage of curculio injury near woodlands. (3) The use of soap as a "spreader," or of flour-paste as a "sticker," did not appear to render the arsenate more effective against the Curculio. (4) The use of 1 lb. of blue-stone (copper-sulphate) in 50 gallons of spray (commercial lime-sulphur) did not lessen the amount of rot but did produce a smutty appearance of the fruit and seemed to delay maturity. (5) Of the several combinations tested none gave better average of results than the standard self-boiled lime-sulphur with arsenate. (6) The sprayed trees matured a more highly colored fruit with less loss from rot than did the unsprayed ("check") trees.

5. *Soap and Water for Aphids*.—No new data.

6. *Insect Life of North Carolina (Insect Survey)*.—To work out the areas of distribution of our native insects, to determine the "life-zones" of the State, and perhaps ultimately to be able to classify our insects into groups according as they occur throughout, or only in restricted parts of our state—these points have been sought in this project which we well know may occupy the attention of more than one generation of entomologists. It is a long-time project, embracing the collecting and recording of scores of thousands of specimens, of thousands of different species of insects. It has been my own favorite project for many years, and in its prosecution I have enlisted the efforts of every assistant so far as circumstances would allow. Yet it is conducted piece-meal, and does not occupy the exclusive or principal attention of any one of the workers. Many facts, odd, instructive or mildly startling, have been placed on record in regard to insects, some of which are destructive, some only potentially destructive, and some apparently "neutral" in their relations to man. Examples: The Yellow-fever mosquito (*Stegomyia fasciata*) is common at Raleigh in late summer. The Northern Grape Root-worm (*Fidia viticida*) (a serious pest in the region of the Great Lakes) has been taken at Raleigh in several different years. The Sweet Potato Weevil (*Cylas formicarius*) (regarded as a coast-wise species) has been recorded from Southern Pines and from Hendersonville in the mountains. A species of scorpion-fly (*Panorpa rufa*) which for years was known only from a single specimen in "a British Museum," has been taken in at least two localities—and another scorpion-fly (*Panorpodes caroliniensis*), has been taken only in the mountains of North Carolina, while its nearest known relative is a native of Japan! Many more

instances of this sort might be mentioned. This project is designed to gradually throw a comprehensive light upon our whole insect fauna, and will of necessity require long continuance. I wish it were possible to employ a skilled collector to assign solely to this project.

7. *Field Studies of Black Corn Weevil*.—In the fall of 1916 Mr. Leiby and myself began some field studies of the black Corn Weevil (*Calandra oryzae*) at the Black Lands Station (Washington County) to determine what methods of culture or of handling of the corn crop would affect its abundance. As yet it is too early to discuss the details of this.

*Acknowledgments.*

It is a pleasure to report that the entire work has gone forward with only the best of feeling among the several workers concerned, and to acknowledge the kindly support of yourself as director. All who have ever been associated with this office are still its friends, and although the war-period upon which we have now entered may bring modifications of plans or changes in personnel, yet I believe that the work which is being prosecuted is giving substantial returns, which cannot but strengthen our people for the tasks ahead.

Very respectfully submitted,

FRANKLIN SHERMAN,

*Chief in Entomology.*

X

## REPORT OF ENTOMOLOGIST.

To the Director:

I submit, herewith, a brief report of the work in Entomology for the fiscal year ending June 30th, 1917.

During the past year we have completed the study of the biologic phases of the study of the Southern Corn Bill Bug (*Sphenophorus Callosus Olivier*) and the detailed results have been published in Technical Bulletin No. 13. At the same time the more economic phases of this subject were published in Extension Circular No. 19. This then closes the Adams Fund Project on the Genus *Sphenophorus* save for the writing up of the morphological phases of this genus for technical magazines.

The Adams Fund Project on the Genus *Chrysomphalus* has been pursued during the past year, and, at the present time, we are engaged in writing up the biological phases of this genus as it relates to the Gloomy Scale.

The Bruchus Project has progressed satisfactorily, especially in regard to a study of a new method of treating cowpeas to prevent weevil injury. A detailed report of these results has been published in the *Journal of Economic Entomology*, February, 1917, under the title "Lime as an Insecticide." The results of these experiments place in the hands of the farmer for the first time a safe and effective remedy for these pests, and, at the same time, one which is so simple and cheap any farmer can make the application. Since reporting on these experiments, further experiments on a larger scale have shown that where cowpeas are stored in large amounts, the lime may simply be spread in a layer on top of the peas and still accomplish the same result.

The Hatch Project on the correlation time of planting and the injury to corn by certain corn insects, especially the corn root worm, has been continued. Unfortunately, the spring was so backward and wet that our results are not satisfactory. In some cases plantings have been interfered with, but, as a rule, we have made fairly regular plantings at the Central Station, the Pender Branch Station, Washington Branch Station, and the Edgecombe Branch Station. However, we do not expect to be able to draw any very reliable conclusions from the results of these plantings this year. This in a brief way covers the work during the past year, which has been marked by satisfactory progress along all lines.

Respectfully submitted,

Z. P. METCALF,  
Entomologist.

## REPORT OF THE DIVISION OF HORTICULTURE.

*To the Director:*

The experimental work of the Division of Horticulture is being continued along the lines of the projects laid down in previous reports. Some work that has been in progress for a number of years has been completed as far as the field work goes and the data are being prepared for publication. Some new projects have been taken up.

## PECAN WORK.

(Coastal Branch Station, Truck Branch Station and Piedmont Branch Station.)

1. *Variety Testing.*—Twenty-two of the most important southern varieties are included in this test which has been carried on for 10 years. Gratifying results are being secured from this work as certain varieties are showing marked adaptability to North Carolina conditions while others are proving to be undesirable. At this time valuable recommendations regarding pecan varieties for planting in this State can be made. It has been shown that certain varieties that are very satisfactory in the Gulf Coast Section are owing to our shorter growing season almost worthless here. It is evident from even the comparatively short length of time that the experiment has been conducted that the variety factor is of extreme importance in determining the success or failure of a pecan orchard in this State.

II. *To determine the value of the Pecan as a commercial proposition in this State.*—At 8 years of age the experimental pecan orchards bore what might be considered their first commercial crop. At the age of 10 years, these orchards show that by the proper selection of varieties and careful attention to cultural practices pecans are valuable in the Coastal Plain of North Carolina as a commercial crop. As a result of the test at the Piedmont Branch Station, it is strongly indicated that as a commercial proposition pecan growing should be confined entirely to the Coastal Plain.

III. *Securing individual tree performance records.*—Performance records of the individual pecan trees in the experimental orchards at the several stations were continued this year as in former years. As a result of this work, it is noted, that trees of the same variety under identical conditions are uniformly heavy yielders while others are very poor yielders; that some produce uniformly large nuts and others uniformly small nuts. These results indicate the possibility of bud variation in the pecan and suggest the value of bud selection in propagating and top-working pecan trees.

IV. *Cultural practices.*—The value of correct cultural practices such as tillage, the use of cover crops and leguminous crops, is clearly shown



in the increased size of trees and in the increased size and number of nuts produced when compared to trees and their products grown in sod.

V. *The value of the different varieties as regards cracking quality.*—The cracking test is a necessary adjunct to the performance record of a given variety in determining its value in a certain section. Very often a variety is highly satisfactory from a productive standpoint but the cracking test shows the variety to be nearly worthless from an utility viewpoint. The cracking test determines the per cent of unbroken halves the variety will crack out, the per cent of shrunken kernels, the per cent of physiological spot, the per cent of faulty nuts, the shape and size of the kernel, the texture, quality and flavor of meat, the per cent of meat, and the thickness of shell. Such a cracking test was conducted this year, as in former years, and as a result certain varieties that were satisfactory from a productive standpoint proved to be totally unsuited to North Carolina conditions.

VI. *Top-working undesirable varieties.*—Progress should be reported in the experiments in top-working pecans. The investigations show that good results can be secured by both the “patch bud” method and the “slip bark graft” method. While this has not been concluded, results indicate that success rests as much in the selection of suitable bud and graft wood as in the technique of the operator. By using properly selected buds, an average “live” of 85% has been secured by the “patch bud” method and a “live” of 70% by the “slip bark graft” method.

VII. *Bud selection.*—As the individual performance records of the different trees suggest the possibility of improving and standardizing individual yields by bud selection, several trees of known performance ability were top-worked with buds from a high yielding tree while several trees were budded from a low yielding tree. It will be several years before results can be secured from this work.

VIII. *Pecan breeding.*—The test orchard in pecan breeding work was set in the spring of 1914. Most of the trees have made a satisfactory growth but no nuts have yet been produced on any of the trees.

#### PEACH WORK.

1. *Peach breeding work* (Truck Branch Station).—It is the object of this project to produce (a) earlier maturing white and yellow fleshed varieties of peaches, (b) earlier freestone varieties of both white and yellow fleshed peaches, (c) varieties hardier in bud, (d) varieties with a longer resting period.

Selection, production of seedlings, and crossing are the methods of procedure in this project. To furnish working material to carry on this project, a variety orchard containing over 60 different varieties of peaches was planted at the Truck Branch Station in Pender County this last season. Very little can be done on this project until this orchard reaches bearing age.

II. *Hardiness of flower buds of different varieties.*—Using the variety

orchards of the different branch stations and also commercial orchards data have been collected on the susceptibility to cold injury of different varieties.

III. *Variety Tests*.—The testing of different varieties on the several branch stations has been continued from year to year.

IV. *Rest Period Studies*.—The influence of different degrees of pruning in prolonging the rest period was studied. It is evident that severe pruning causes a prolongation of the rest period in winter which is a highly desirable condition for peach trees in this State. Often the prolongation of the "rest period" in winter a few weeks means the difference between a crop and a crop failure.

V. *Summer Pruning Young Peach Trees*.—Among fruit growers in this State it is a debatable question whether or not it is advisable to summer prune young peach trees. To gain some information on this question a number of trees in an orchard that had just been planted were summer pruned while the remaining trees were not. It will be next year before results can be secured from this work.

VII. *Thinning Peaches*.—During the last three seasons experiments in thinning peaches have been conducted at the Coastal Station and the Piedmont Station. Results from these experiments show conclusively the value of thinning in producing fruit of larger size, more uniform size, and of higher color. It is evident, too, that proper thinning increases the vigor and longevity of the tree.

#### THERMAL ZONE WORK.

The work begun in 1912 in coöperation with the Weather Bureau of the United States Department of Agriculture to study the phenomena known as Thermal Belts was completed in 1916 as far as the field work went. Since that time, the vast amount of records collected at the different stations are being worked over by the experts of the Weather Bureau under the direction of Professor Cox in charge of the Chicago Station. A topographical map of Western North Carolina has been prepared with contour lines showing the locations of the observation stations and the mountainous nature of the surrounding country. In order to make this work of practical as well as of scientific value, we will prepare this winter a map showing the location of railroads to available fruit zones at 500 foot contours from 1,500 to 3,500 feet.

#### VARIETY WORK IN POMOLOGY.

Observations, on the behavior of the better known varieties of fruits in the different sections of the State, have been made on the Experimental substations and on commercial orchards throughout the State. Much time and care has been taken in writing and revising descriptions of almost all of the important varieties of fruits grown in this State. These descriptions are to be used in publications and are being used in the office as an aid in identifying varieties of fruit sent in from over the State.

## NATIVE FRUITS OF NORTH CAROLINA.

Considerable time has been spent on this subject and it is being pushed towards a conclusion. The place of origin, the history and the description of a number of varieties of North Carolina origin have been added to the already large list. Where opportunity offered, the descriptions, of varieties secured previous to this season, were verified or corrected. Paintings and photographs have been made of the most important varieties.

## DRYING, EVAPORATION AND DEHYDRATION OF FRUITS AND VEGETABLES.

As a food conservation project, investigations were made regarding the different methods of preserving fruits and vegetables by drying. To supply the demand for information regarding drying a bulletin entitled "How to Dry Fruits and Vegetables for Home Consumption" was prepared. That there was a large amount of interest in drying has been shown in the requests for this publication. As the result of our investigations along this line, a dehydrating plant of commercial size was located at the State Hospital. It has been giving very satisfactory results.

## VEGETABLE WORK.

The vegetable testing work as outlined in former reports has been continued and data recorded. Confirmatory data were secured at the Pender Substation on the production of varieties of sweet potatoes most suitable for storage purposes. Work was begun on the Mountain Substation on the production of late cabbage for storage purposes. Various methods of storing this crop are now being tried to hold over the cabbage for late winter and early spring markets.

Since the land has been cleared and drained on the black soil belt station at Wenona, a number of tests were begun this season to try out in a preliminary way the kinds of vegetables best suited for growing in muck soils. A full line of vegetables were planted in the spring and careful notes kept on their behavior during the summer. Confirmatory data were secured on the behavior of many of these classes of vegetables by the planting of a full garden and noting the planting dates best suited to each crop. Sufficient data were secured to warrant the more extensive testing during the coming season of the types of vegetables found to be best suited to that type of soils.

W. N. HURT,  
*Chief, Division of Horticulture.*

## REPORT OF THE HORTICULTURIST.

*To the Director:*

I submit the following report for the year ending June 30, 1917:

The investigations being made at West Raleigh are along the line of original research in connection with the *Rotundifolia* grapes, and are supported by funds appropriated for the purpose under the provision of the Adams act. They have been in progress since 1907, reports in bulletin form having been made from time to time since the publication of the first one in April, 1909. These have constituted a distinct addition to the literature on the subject of heredity and have been widely quoted in contemporaneous writings.

The department now has growing in the experimental vineyard something over 4,500 seedlings, which have been secured by hand-crossing and which represent all of the series from No. 3 (1910), to No. 9 (1916), inclusive. Series 1 and 2 (1907 and 1908), have been discarded. Of the earlier series, large numbers have been eliminated owing to determinations having been made as to their lack of value. The most promising individual plants have been transplanted to more permanent positions for further study and use in the making of future crosses.

During last year, a large number of crosses were made in accordance with plans previously outlined, but owing to vicissitudes in connection with the season, relatively few seedlings were obtained this year. During the year, however, a large number of seedlings which had not fruited up to the present year, yielded a large amount of data which has been secured and recorded.

During the year, also, partial report was made as to the progress of the investigation in connection with the inheritance of sex. This report appears in Technical Bulletin No. 12, published in January, 1917. The principal points determined and reported therein being the establishment of the facts that—

1. Hope, the first discovered hermaphrodite vine of the species *Vitus rotundifolia*, is self-fertile;
2. That the floral types in *Vitus rotundifolia* are transmitted to the progeny of crosses in definite ratios;
3. That upright stamens in hermaphrodite flowers of *Vitus rotundifolia* are correlated with normal, viable pollen, and self-fertility; and, conversely, that the reflex type of stamen in hermaphrodite flowers is always associated with defective pollen, and self-sterility; and,
4. That it seems very probable that self-sterility in *Rotundifolia* grapes has come about through the suppression of the pistils and the consequent power to function. Removal from the wild condition and cultivation exerts considerable effect in the line of regeneration of the pistils.



Not all of the ratios by which floral types are transmitted have been determined and further report on this matter will be made at some future time. The work, as outlined in a general outline, includes various studies along the following lines:

1. Inheritance of sex.
2. Productivity.
3. Inheritance of colors of fruits.
4. Inheritance of size of fruits.
5. Quality characters.
6. Hybridization with other species.

During the past year, data on various points bearing upon these several lines of study have been secured and recorded, but as it was incomplete, no further report was made than that mentioned above. During the spring further crosses were made and seeds from these will be available in the autumn.

In connection with the work on hybridization with other species, investigation is being made with respect to resistant stocks. Numerous individuals have been propagated upon native stocks for this purpose.

In closing this report, the writer wishes to commend Mr. L. R. Detjen, who has been associated with this work from its inception, for his zeal and fidelity.

Respectfully submitted,

J. P. PILLSBURY,  
*Horticulturist.*

## REPORT OF THE VETERINARY DIVISION.

*To the Director:*

I herewith submit a report of the work of the Veterinary Division for the year ending June 30, 1917.

The following work has been performed during the year:

*"Contagious Abortion" Infection.*—Effort has been continued to determine the prevalence of and suitable control measures for "contagious abortion" infection (abortion disease), among various classes of animals, but with particular reference to dairy cattle.

Attempt has been made to recognize its presence in the various herds by the history obtained from those herds as to abortions, premature births, inflammations of the uterus following calving, with or without retained afterbirth (foetal membranes), sterility of females (temporary and permanent), frequent inflammation of the udder, calf scours (white scours) and calf pneumonia.

Likewise, several kinds of laboratory examinations and tests of material obtained from the animals were made to discover the presence of the specific infection. The examinations consisted of microscopical and cultural, the tests of complement fixation and agglutination.

Some cases of sterility have apparently been rendered fertile again by massaging affected ovaries and by flushing the uterus, having its mucous membrane altered.

*Influenza (Shipping Fever) Complications.*—Some study has been made as to the nature and control measures of the serious complications following influenza of horses and mules.

The rather frequent finding of a bipolar staining organism in such cases led to the belief that it belonged to the Hemorrhagic Septicemia group. The clinical symptoms and lesions likewise often suggested the presence of such an organism.

Opportunity was afforded to prepare some bacterial vaccine containing this organism and to observe apparently good results in a number of affected British horses and mules at the British Depot, at the Spencer stock yards. It is believed the best results would be obtained by using this product as a preventive agent, or the earlier use as a curative, the better.

*Laboratory Examinations.*—As in previous years, numerous laboratory examinations have been made of materials sent us for diagnosis and identification. Among such materials were various tissues, blood, milk, feed, pus, foreign matter removed from animals, parasites, and other material.

Several infectious diseases were diagnosed by injecting suspected material into laboratory animals and reproducing the disease.

Autogenous bacteria were made for the treatment of a number of infectious diseases of animals.

Autopsies were conducted upon some twenty laboratory animals for other departments of the Station.

*Visits to and Autopsies Upon Station and College Animals.*—Some forty visits were made to sick and wounded animals belonging to the Station and the College of Agriculture. Autopsies were held upon some twenty experimental and college animals. Slaughter examinations were made of some twenty experimental animals to be used for market puposes.

The tuberculin test was applied to the college dairy herd consisting of forty-two animals. No reaction, or even suspicious reactions, were obtained from either the subcutaneous or intra-dermal tests.

*Changes in Personnel.*—Dr. J. I. Handley, who had been largely conducting the laboratory examinations, and doing some of the field work, resigned January 1st. Since that time, the laboratory work has been carried on by Messrs. J. A. Simms and N. B. Tyler.

*Recommendations.*—In view of the fact that the direct and indirect losses from the various diseases of animals in the State are quite large, and that the knowledge concerning the causes and the control of many of these diseases is quite limited, we respectfully recommend that adequate provision be made for investigational work in animal diseases.

The following from the last official government reports gives an estimate of the direct losses from deaths of animals in North Carolina for the past year ending March 31, 1917. The indirect losses from sickness and unthrift, but not resulting in death, amount to fully as much as the former. Losses in pet animals and fowls not determined.

APRIL 1, 1916, TO MARCH 31, 1917.

|                                                                               |           |                   |
|-------------------------------------------------------------------------------|-----------|-------------------|
| Horses having died, 3,700; Av. price, \$125-----                              | \$462,500 |                   |
| Mules having died, 4,000; Av. price, \$150-----                               | 600,000   |                   |
|                                                                               |           | \$1,062,500       |
| Milk cows having died, 9,765; Av. price, \$39-----                            | \$380,000 |                   |
| Other cattle having died, 11,284; Av. price, \$19-----                        | 208,909   |                   |
|                                                                               |           | 788,909           |
| Sheep having died, 3,920; Av. price, \$4-----                                 | \$15,680  |                   |
| Lambs having died, 1,000; Av. price, \$3-----                                 | 3,000     |                   |
|                                                                               |           | 18,680            |
| Swine (all diseases, 5 per cent of total), 77,500; Av.<br>price, \$9.70 ----- |           | 751,750           |
|                                                                               |           | <hr/> \$2,621,839 |

Respectfully submitted,

G. A. ROBERTS,  
Veterinarian.

## REPORT OF THE DIVISION OF PLANT PATHOLOGY AND BACTERIOLOGY.

*To the Director:*

The following brief report covers the work of this Division for the fiscal year ending June 30, 1917:

*Soil Bacteriology (in Coöperation with the Division of Chemistry).* Since the investigations upon this problem were primarily chemical in nature, the work has been taken over in its entirety by the Division of Chemistry.

*Apple Root Rots.*—A report, covering the result of investigations to date, on this project has been prepared and has appeared in the *Journal of Agricultural Research*. Subsequently, our findings have been confirmed at the Virginia Station and the disease has been reported from New York and Indiana.

*Lettuce Drop.*—The studies which were previously reported as in progress will be completed during the coming year and submitted for publication as a Station bulletin.

*Watermelon Wilt Control.*—Further attempts to improve the rind of the North Carolina wilt resistant melon, called "Conqueror," are being made by the Office of Cotton and Truck Investigations of the United States Department of Agriculture. Our work on this project has been confined to a multiplication of the seed for distribution within the State.

*Control of Tobacco Wilt (in Coöperation with the U. S. Department of Agriculture).*—It has been found that tobacco wilt can be successfully controlled by crop rotation. The results of the studies of natural resistance of species and varieties of tobacco, both native and foreign, of the influence of chemicals and fertilizers, and of various systems of cropping and rotation are given in Bulletin 562 of the U. S. Department of Agriculture in coöperation with the North Carolina Agricultural Experiment Station. A report covering the distribution of tobacco wilt within the State and the occurrence of the same organism upon a considerable number of additional hosts, both weeds and cultivated plants, has appeared in *Phytopathology*.

Aside from these projects, studies have been made of a disease of summer squashes and a technical report upon these studies has appeared. A blight or wilt disease of soybeans, caused by an organism identical with the one which causes cowpea wilt, has been investigated and duly reported. Furthermore, it has been found from studies conducted in coöperation with the Division of Animal Industry, that white snake-root, *Eupatorium urticæfolium*, is the cause of trembles. A report containing the data upon which this conclusion is made, has appeared and it is planned during the coming year to issue a complete report of these studies.



Considerable time has been devoted to the Plant Disease Survey and to the letters of inquiry relative to the more common plant diseases.

Changes in the staff have involved the resignation of E. E. Stanford, who has been appointed to work with the Bureau of Chemistry at Washington, D. C.

A number of publications, together with brief scientific notes, reviews of books and scientific articles, have been prepared by this Division during the year, the most important of which are listed as follows:

1. A squash disease caused by *Choanephora cucubitarum*. Jour. Agr. Research, v. 8, No. 9, 319-328, Pls. 3, 1917. (By F. A. Wolf.)
2. *Fusarium* blight or wilt of the soybean. Jour. Agr. Research, v. 8, No. 11, 421-440, fig. 1, Pl. 1, 1917. (By R. O. Cromwell.)
3. Control of Tobacco Wilt in the flue-cured district. U. S. Dept. Agri. Bul. 562, 1-20, figs. 5, 1917. (By W. W. Garner, F. A. Wolf and E. G. Moss.)
4. Studies on *Bacterium solanacearum*. Phytopath., v. 7, No. 3, 155-165, fig. 1, 1917. (By F. A. Wolf and E. E. Stanford.)
5. *Eupatorium ageratoides*, the cause of trembles. Jour. Agr. Research, v. 9, No. 11, 397-404, Pls. 3, 1917. (By R. S. Curtis and F. A. Wolf.)
6. *Xylaria* root rot of Apple. Jour. Agr. Research, v. 9, No. 8, 269-276, fig. 3, Pls. 3, 1917. (By F. A. Wolf and R. O. Cromwell.)
7. Studies on resistance of tomatoes to bacterial wilt. N. C. Expt. Sta. Ann. Rept. 40. (By E. E. Stanford.)

Respectfully submitted,

FREDERICK A. WOLF.

REPORT OF DIVISION OF MARKETS AND RURAL  
ORGANIZATIONS.*To the Director:*

This report is for the year ending June 30, 1917, and covers the experimental work in the Division of Markets and Rural Organization, conducted jointly by the North Carolina Department of Agriculture and the North Carolina State College of Agriculture and Engineering, in coöperation with the United States Department of Agriculture under the agreements and plans entered into by these institutions for the conduct of all agricultural work of this kind in the State.

## INVESTIGATION OF PRODUCER'S PRICES.

The prices received by producers for strawberries, Irish potatoes, cotton, corn, peanuts and soybeans, have been investigated to determine the marketing conditions under the varying circumstances prevailing in different communities. These investigations show that the small size farmer whether he be a grower of strawberries or a producer of cotton, does not receive as much for his products as the farmers with larger crops. The large sized producer need not depend upon local markets. Dependence upon a local market makes a monopoly of that market and means generally lower prices, especially for the small size producer. The large size producer may be paid a higher discriminatory price on a local market to prevent his seeking an outside market, or to prevent farmers organizing, or to break up a farmers' organization when formed. The local market, generally, does not encourage grading farm products. To avoid any hard feeling from seeming to discriminate, local buyers are inclined to pay a flat price for produce. Such a practice is recognized by the trade as being responsible for farmers not grading their products as they should. If farmers do not know the grade of their products, or if they do not grade and pack them according to market requirements, they are in no position to sell advantageously in outside markets. This method on the part of buyers of not paying for food products strictly according to quality and grade is a discriminatory practice, which is prohibited by section 5 of the Food Control Act, according to which all discriminatory practices of licensed middlemen are unlawful.

Early Irish potatoes sold this year at prices never heard of before, notwithstanding the unusually large crop, shipments amounting to 4230 cars as compared with 2760 cars in 1916. Many North Carolina growers averaged \$8 per barrel for their crop. The Carolina Potato Exchange averaged \$7.94 per barrel for all grades of potatoes shipped between June 1st and July 2d, or \$8.03 per barrel for grade one, \$5.43 for field run, and \$3.34 per barrel for culls. The average price obtained by growers in different parts of the State, according to special reports,

was \$6.83 per barrel for grade one and \$4.68 for grade two. The average price received for contract potatoes of all grades as reported was \$4.68 per barrel, as compared with \$6.79 per barrel for potatoes which were not contracted for. Potato growers in North Carolina lost nearly a million dollars through contracting ahead last spring. If growers would save enough this year to buy seed and fertilizer for cash, then they would be free to organize to sell on grade at the market price.

The New York market between May 30th and June 28th averaged, according to the market news service reports, \$9.05 per barrel for grade one in 1917 and \$4.11 in 1916, and \$6.28 per barrel for grade two in 1917, and \$2.62 per barrel in 1916.

This Division, in coöperation with the Virginia Division of Markets, is inaugurating a new policy this year in regard to the marketing of the peanut crop. Information is being gathered from all the peanut-producing states concerning quality and yield of crop in order that the growers, in a conference to be held at Suffolk, Virginia, on November 20th, may have the necessary knowledge to determine what, under existing conditions, would be a fair price for this year's crop. Notwithstanding the increasing high cost of production, the price of peanuts remained practically the same during the years 1910 to 1916, inclusive. The average price of peanuts in North Carolina during the months that the farmer disposes of his crop, according to the Bureau of Crop Estimates, was 4.5 cents per pound in 1916, and 4.6 cents per pound for the period from 1916 to 1917, inclusive. The price rose to 7.26 cents a pound on an average during the months from May 15th to September 15th, inclusive, 1917. This would indicate that the farmers of this State received 2.76 cents a pound less than they would for last year's crop, or in the neighborhood of \$4,226,731.99 less than they would had they been paid according to prices quoted in later months. The above figures are based upon the Bureau of Crop Estimates reports. But if the calculations are based upon special reports of producers' prices, the peanut growers would have received \$4,904,232.22 more had they been able to sell their crop at the prices prevailing between May 15th and September 15th, 1917. This is on the assumption that the 1916 peanut crop is the same size as that of the census year 1909. Beside prices, the Suffolk conference will consider cost of production, feasibility of establishing State grades of peanuts, and of forming an organization of peanut growers to meet yearly at Suffolk, and to serve such purposes as market conditions may demand.

#### MARKET QUOTATIONS.

##### *Daily Market News Service.*

A daily market wire service for early and late Irish potatoes, sweet potatoes, cantaloupes, watermelons, and apples, has been maintained this year in coöperation with the Federal Bureau of Markets. Twenty-

one thousand nine hundred and thirty-four bulletins have been mailed from the Elizabeth City office to early Irish potato growers and shippers, 21,100 bulletins from the Laurinburg office to cantaloupe and watermelon growers and shippers, 13,444 bulletins from the Elizabeth City office to sweet potato growers and shippers, and 8,210 bulletins from the Waynesville office to the growers and shippers of late Irish potatoes and apples. The newly established daily market news service operated at Waynesville by this Division, in coöperation with the Federal Bureau of Markets, is bringing for the first time news of general market conditions to the small growers of Irish potatoes and apples scattered through the mountains of Western North Carolina. Such reports are especially valuable in keeping small farmers informed as to the amount of shipments from competing producing sections, numbers of cars arriving on leading markets, and the prices paid each day on those markets. All of our price investigations show the necessity for such a wire service, that is, if production is to be encouraged.

### *The Weekly Price Report.*

The Weekly Price Report now covers prices upon corn, oats, wheat, cowpeas, soybeans, Irish potatoes, sweet potatoes, cabbage, apples, butter, eggs, poultry, cheese, hogs, cotton, cotton seed and cotton-seed meal. Seventy-six thousand seven hundred and ten Weekly Price Reports were mailed out during the last year. In addition to keeping farmers and merchants informed of prices prevailing in markets in this and other states, the Weekly Price Report serves the special purpose of giving information to railroads which are interested in promoting immigration into this State.

### *A Monthly Market Review.*

A monthly review of North Carolina markets will be published later in the year. These reviews will be based upon special reports of prices received by producers in different sections of the State. The purpose will be to obtain and distribute information of prices producers are receiving, the prices they are holding for, and to publish this and similar information from other states to the extent that they will coöperate in following a similar system of obtaining information from producers.

In the United States as a whole, market quotations have been obtained from buyers, and generally published by buyers. In Copenhagen butter prices have been published by producers. Manufacturers in the United States have found it to their interest to publish information of the prices at which they sell their products rather than to rely upon buyers. They have established special committees with a paid secretary to collect and distribute information from and to the membership. Even when such committees do not fix prices, their united action helps to crystallize sentiment in favor of maintaining prices.



All price investigations conducted in this State this year, as well as in previous years, show as wide differences in prices as those which have been published in the Weekly Price Report. To illustrate, seven counties report that producers are receiving on November 1st \$1.20 per bushel for cotton seed, one county 70 cents, one 80 cents, and one 96 cents, and the average for the State, 27 counties reporting, is \$1.07 per bushel. Some farmers in North Carolina reported to be holding cotton seed for an average price of \$1.33 per bushel.

The discrepancy in corn prices in different sections of the State is still greater. According to special reports, corn on November 1st was selling in Iredell County at \$1.15 a bushel, in Burke, Chatham, Henderson, and McDowell counties at \$1.25 a bushel, and in thirty counties for an average price of \$1.71 a bushel. Thus, in many places farmers are selling much below the market price of Western corn delivered in this State, as shown by the Weekly Price Reports and letters just received. Later, in the spring, North Carolina corn will sell for as much or more than the price of Western corn delivered. No. 2 white Western corn would cost \$2.29 to \$2.32 put down in Raleigh, N. C., and more or less in other North Carolina towns, according as the freight rate to those towns is more or less than fifteen cents a bushel, the rate from Chicago to Raleigh. Undoubtedly, as soon as farmers begin selling there will be a slump in prices in every town in the State where a surplus of corn is produced. Merchants cannot sell much, if any, corn this fall. Therefore, what they buy will be bought at a discount and there always will be some farmers who are forced to sell at some price, especially until they organize credit unions to take care of their temporary needs.

#### ORGANIZATION FOR MARKETING.

##### *Potatoes and Apples.*

This fall a small organization of growers of late Irish potatoes and apples was formed in Haywood County, and incorporated under the coöperative law of the State as the Mountain Growers Exchange of Western North Carolina. As soon as the Exchange began to operate under the guidance of a manager furnished by this Division, the price of potatoes rose from eighty cents to a dollar a bushel, and later when the Exchange raised the price to \$1.20 a bushel, local buyers raised their price accordingly. At the same time buyers in Hendersonville were only paying one dollar a bushel. Thus the Exchange had the effect of raising the price of potatoes in the Waynesville section fifty cents a sack to both members and nonmembers.

While the newly established market news service will help inform the small grower of market conditions, organization is necessary to enable him to profit by such knowledge. The Exchange has adopted

the United States potato standard, and has graded and sold their potatoes according to this standard. The Exchange has secured two government contracts. In fact, the demand from different markets at good prices has been much greater than the supply of potatoes.

The Carolina Potato Exchange had a successful season in spite of the bad condition of the crop. The manager, loaned by this Division, obtained exceedingly good prices for the members, considering the fact that late frosts and heavy rains at digging time made the crop of such poor quality that a large part of it was too small to grade. Because of the Exchange, non-members received much higher prices than they otherwise would have. Buyers made tempting offers to the members of the Exchange and paid such high prices for a poor grade of potatoes that it was with difficulty that any standard of grades was maintained at all.

A State grading law is needed to help the marketing exchanges and North Carolina growers generally. If we allow other states to get ahead of us in the adoption of the grading law recommended by the Federal Bureau of Markets, our growers are going to be at an increasing disadvantage in selling their less well graded stock in northern markets.

A whole bulletin could be written to show the discriminatory practices of buyers to break up organizations of producers. We have recommended to the United States Food Administration the adoption of the following regulations to govern country shippers in keeping with the Federal Food Control Act:

1. No farm products shall be bought at a flat rate. The price shall vary according to the grade. It shall be considered an "unjust" and "discriminatory" practice for any shipper to pay a farmer the same price for a poorly graded product as for one properly graded, according to the standards accepted by the Food Administration. In the case of farm products in which the United States Department of Agriculture has worked out grades by Congressional enactment or at the request of the Food Administration, the price shall vary according to the scale of differences prevailing upon ten of the leading consuming markets in the United States for the week previous.

2. No shipper shall discriminate between individual farmers in the same locality or between farmers in different localities in the amount paid for the same grade of product at any given time; provided, that differences only to the amount of differences in the rates of transportation shall be allowed.

3. No shipper shall pay a higher price than the market price either for the purpose, or with the effect, of crushing competition.

4. The ownership by shippers of any facilities for transportation which are used by competitors constitutes a discriminatory practice or privilege which is forbidden all licensees under the Food Control Act.

5. No shipper shall make any "unjust, unreasonable, discriminatory, and unfair" charge, commission, profit, or price.

6. Any shipper may authorize agents to sell upon commission. Agents so authorized shall not directly or indirectly buy upon their own account, nor shall any concern in which said agents have any interest buy such products; provided, the shipper may authorize agents to buy such consignment at an agreed upon price. When so bought, the agent shall be allowed no commission.

The weakest part in the whole system of distribution is at the country shipping points, but the hardest to remedy because of the number of such points. Any food control act which does not effectively regulate the conditions under which farmers sell their produce, cannot hope to materially increase production. The Food Control Act gives the greatest opportunity for the government to lay down such conditions as shall make possible the development of permanent marketing machinery among farmers, such as shall increase prices to producers, and correspondingly increase the production, lower the cost of distribution, and reduce the cost to consumers. The trucking capacity of this and other States could be greatly increased if a more stable market and fairer conditions of marketing could be assured, as outlined by the regulations proposed. A State grading law and a law to regulate and license all country shippers should be enacted if living conditions for farmers to organize are to prevail.

### *Cotton.*

The Edgecombe Cotton Exchange organized in the fall of 1915, sold 900 bales of cotton for its members last year. This Exchange has been a very effective help in inducing buyers on the local market to buy cotton according to the grades of our State graders. The excellent warehouse facilities and the grading office at Tarboro, which are both at the disposal of this organization, give it the necessary business equipment to do the very best work. However, the Exchange finds great difficulty in securing bids on cotton. It has not found the leading cotton buyers of the State willing to do business with the organization. This is a difficulty which the wheat farmers of the West had to meet and overcome in organizing farmers' elevator companies. This Exchange should be a model for farmers to follow at each cotton market center in the State. Especially now when the export cotton business has been cut down and the domestic mill business is greatly increased, there is a supreme opportunity for the cotton farmers of this State to develop cotton selling organizations along lines similar to the Edgecombe Cotton Exchange. The railroads are giving the necessary warehouse storage in transit privileges to make possible the concentration of sufficient cotton at one place and its classification in large-enough even-running lots, which should be of interest to North Carolina mills. When, during the war, economy in transportation must be realized, it should be easier to induce our mills to buy North Carolina cotton in so far as the right staple is available. A circular has been published to show the mills

where cotton of different staples can be found, and an offer made to put mills in touch with growers and shippers of cotton and to furnish them samples. As a result some business with the mills has already been developed by the cotton grading offices.

### *Hogs.*

In the preliminary survey of hog raising, it has been found that many counties have sufficient hogs to ship in carload lots to Richmond, Baltimore and Jersey City markets, or to local packing houses. With relatively low local prices of pork, there has been little encouragement to increase its production. The services of a specialist in hog and grain marketing have been secured to begin work on December 1st. Shipping clubs will be organized wherever there are sufficient hogs or grain to ship in carload lots. When North Carolina farmers realize that the world's markets are open to them, they will breed better hogs, and in the peanut section harden them, according to the methods advised by the Animal Husbandry Division, so that they may obtain the top of the market. Hog producers will be put in touch with growers having a surplus of corn.

### COTTON GRADING AND WAREHOUSING.

The Commissioners of eight counties this year made the necessary appropriation to secure the cotton grading service, which is being operated in coöperation with the Federal Bureau of Markets. Cotton this season has been graded in the grading offices located at Raleigh, Lumberton, Clinton, Wilson and Tarboro, for farmers and buyers in the eight counties as follows:

| <i>Counties</i> | <i>Bales Graded for</i> |               |
|-----------------|-------------------------|---------------|
|                 | <i>Farmers</i>          | <i>Buyers</i> |
| Robeson -----   | 5,219                   | 226           |
| Bladen -----    | 1,011                   | 94            |
| Wake -----      | 764                     | 148           |
| Onslow -----    | 591                     |               |
| Wilson -----    | 1,816                   | 162           |
| Edgecombe ----- | 2,906                   | 792           |
| Pender -----    | 287                     |               |
| Sampson -----   | 1,884                   | 1,020         |
| Total -----     | 14,478                  | 2,442         |

Last season during the year ending June 30th, about 65,000 bales of cotton were graded for about twenty-five thousand farmers in twenty-two counties. The samples from which the grades are determined are drawn by the ginner after the bale is ginned and mailed to the nearest grading office. The grading service shows farmers that a large part of their cotton is above middling, on an average one-third. With each grade certificate the farmer is mailed a statement of just how many points on or off middling his cotton grades, and how much this will



amount to for the whole bale. From this the farmer who knows current quotations can figure the price of his cotton.

The grading service is increasingly commanding the support of cotton buyers. Two thousand four hundred and forty-two bales of cotton were graded for cotton buyers this year. Buyers, as well as farmers, are put in touch with cotton mills which may be interested in purchasing a particular grade and staple of cotton. In Sampson County much more cotton has been graded this year than last, in the main because the grading office has been located in the county. This has permitted the grader to come into closer contact with farmers, buyers and ginnerers. This, especially, until farmers have been educated to the value of the grading service, seems to be the most desirable method, and should be followed, as far as funds permit, until a law is secured which shall require all ginnerers to be bonded and paid for giving a responsible sample and weight of each bale ginned.

Last season about ten thousand bales of cotton were graded for twenty-five cotton mills, and this season 1574 bales have been graded to date. The interest of the mills in sending in the samples is to learn whether the samples represent the cotton according to grades contracted for. In some cases, our graders help in the settlement of disputes between the mills and cotton buyers. Our interest in grading mill cotton is (1) in determining to what extent mills obtain the grade of cotton they think they purchase; (2) to learn the price paid by mills for a given grade of cotton. The latter information will enable us to determine the difference between producers' and consumers' prices for the same grade and upon the same date. This will give us data for a bulletin upon a subject which has not yet been covered.

We have coöperated with an expert furnished by the Federal Bureau of Markets, in studying the warehouse needs of the State and in informing warehouse operators of the advantages of the United States Warehouse Act. With ample and well distributed licensed bonded warehouses storing cotton classed by licensed graders, farmers should be able as never before to save loss from exposure, obtain reasonable credit, and to organize to sell on grade when and where the best prices prevail.

#### ORGANIZATION AND SUPERVISION OF CREDIT UNIONS.

During the last year seven credit unions have been organized, making fifteen organized to date. The membership of the credit unions has increased from 285 to 527, the depositors from 55 to 181, and the total resources from \$7,471.42 to \$19,515.65, the number of borrowers from 65 to 136, and the amount loaned from \$5,773.73 to \$14,518.14. The main results achieved by these new coöperative banking institutions are (1) encouragement of savings among young and old; (2) borrowing from banks at five per cent interest; (3) loans to members at six per cent, and (4) encouragement of coöperative cash purchases of supplies.

Junior Savings Clubs have been organized in connection with several of the credit unions. The Superintendent of Schools of Mecklenburg County has approved of the plan which we have worked out for collecting savings from the children through school teachers. This plan will be put in operation this fall in the schools adjoining credit unions in several counties. It is frequently found that the older folks become interested in the credit unions through the interest of the children in saving.

The three credit unions for which we have data, Carmel, Lowe's Grove and Drowning Creek, calculated that they saved all together \$2,209.66, by paying cash over what the supplies would have cost if bought on time. The approval of the Governor of North Carolina of farmers organizing credit unions and of their depositing their savings in credit unions or banks, should encourage farmers to take hold of this work of gathering savings in their own coöperative banks and of developing coöperate credit in the country at low rates of interest.

#### LONG TIME LOANS.

Since the Federal Land Bank opened for business in February, 1917, this Division has forwarded applications for loans amounting to \$2,-820,901, or nearly half of the total loans applied for by North Carolina farmers. North Carolina ranks first in this land bank district in the amount of loans applied for, in the total loans approved, and in the amount of loans granted up to October 31, 1917, as indicated in the following report, just received from the Secretary:

|                      | <i>Total Loans<br/>Applied for.</i> | <i>Total Loans<br/>Approved.</i> | <i>Total Loans<br/>Closed.</i> |
|----------------------|-------------------------------------|----------------------------------|--------------------------------|
| North Carolina ----- | \$6,132,419                         | \$2,120,971                      | \$284,615                      |
| South Carolina ----- | 5,320,787                           | 1,413,718                        | 271,065                        |
| Georgia -----        | 2,525,287                           | 488,205                          | 40,700                         |
| Florida -----        | 5,790,307                           | 760,995                          | 32,900                         |
| Total-----           | \$19,768,800                        | \$4,783,889                      | \$629,280                      |

On October 31st loans amounting to \$193,250,945 have been applied for to the twelve land banks in the United States. North Carolina ranks eleventh in the amount of loans applied for in the United States. The eleven states applying for the most loans under the Federal Farm Loan Act have applied for loans as follows: Texas, \$19,167,223; California, \$14,887,389; Montana, \$9,660,919; North Dakota, \$9,155,550; Washington, \$9,044,889; Kansas, \$7,347,477; Nebraska, \$7,137,445; Colorado, \$6,563,242; Mississippi, \$6,352,977; Oregon, \$6,340,778, and North Carolina, \$6,132,419.

From the addresses given by the President, Mr. F. J. H. von Engelken, and the Secretary, Mr. Howard C. Arnold, at the State Farmers' Convention, it was evident that not only the activities of this institution are bringing a large amount of new capital for the use of the farmers of

this State, but also the methods, according to which the loans are granted, are so much in sympathy with the purposes of the agricultural institutions of this State, that this loan agency will be a most powerful factor in the development of the agriculture of this State. Loans are to be granted upon approved plans of farming at a low rate of interest, five per cent, not to speculators, but to farmers who farm their own land, not to landlords who do not operate their own farms, rather to the tenants who have some capital, the landowner to be encouraged to sell to the tenant and to take a second mortgage.

Undoubtedly, there is room for coöperation in this, as in other States, between this Division and the Land Bank to develop second and third mortgage facilities in order to encourage settlement and development of raw lands. In California scientific settlement of lands is being encouraged by this means. A just system of financing the settler, of helping him to organize with others in buying supplies, and in marketing crops, and of furnishing him export agricultural advice to insure a profitable settlement of lands is to take the place of the old system of exploitation, failure, and arrested development.

#### PUBLICATIONS.

During the last year new publications covering the work of this Division have been issued as follows:

- Daily Market News Service Bulletins.
- Weekly Price Reports.
- One U. S. Department of Agriculture Bulletin, 476. A Study of Cotton Market Conditions With a View to Their Improvement.
- One Extension Cotton Grading Circular.
- Two Extension Credit Union Circulars.
- Two Farmers' Market Bulletins.

Respectfully submitted,

WM. R. CAMP,  
*Chief, Division of Markets and Rural Organization.*

## REPORT ON DRAINAGE.

*To the Director:*

I herewith submit report on Drainage for the fiscal year ending June 30, 1917.

The work of drainage investigations in North Carolina has been conducted chiefly along the same general lines as in previous years, with perhaps an increase in the number of experimental studies. The work has become established and more tangible results are being obtained. The work is coöperative, and the division consists of two drainage engineers, F. R. Baker, assistant drainage engineer of the North Carolina Department of Agriculture, and H. M. Lynde, senior drainage engineer, of the Office of Public Roads and Rural Engineering, U. S. Department of Agriculture, together with such collaborators and assistants as may be needed from time to time.

In general, the following investigations have been conducted:

1. The making of the requisite preliminary surveys for the preparation of plans for tile drainage systems, and giving the necessary supervision to the construction of the recommended works, for such experimental tracts selected.
2. The collection of data relating to the proper spacing and depth for underdrains in the various kinds of soil by studying the efficiency of such drains already installed, and by the installation, where practicable, of purely experimental underdrainage systems.
3. The study of the methods of drainage of hillside lands, including the investigation of the slopes, arrangement, spacing, and best methods of constructing terraces and drains.
4. The collection of data to show the proper run-off for which provision should be made in designing drainage systems.
5. The making of preliminary examinations of drainage districts desiring to undertake drainage improvements, for the purpose of determining approximately the feasibility of drainage and the general plans to be followed, and to take up any similar line of investigation that has been mutually agreeable.

Specifically the work for the past year may be divided under the following headings:

1. Farm Drainage.
2. Runoff Data on Drainage Canals.
3. Preliminary Examinations and Reconnaissance.
4. Study of Efficiency of Underdrains on Cotton Valley Farm.
5. Experimental Maintenance Work on Drainage Canals.

## FARM DRAINAGE.

During the past year, preliminary surveys, designs and reports for tile drainage systems have been made on twenty-seven farms in eighteen counties, comprising a total area of about 1,200 acres. Portions of the



systems designed have been installed on some of the farms. The location work on Cotton Valley Farm, Edgecombe County, was completed and this farm now has a 200-acre field completely underdrained by tile ranging from 60 to 100 feet apart where needed, with random lines in other portions. All open ditches, which were a continual care and expense are now done away with and better drainage is assured.

Preliminary examinations, surveys, designs, and reports were made on four farms in four counties comprising a total area of about 1,300 acres for open ditch systems or the prevention of overflow.

Several farms have been visited for the purpose of giving assistance in the location and construction of terraces to prevent hillside erosion.

#### RUN-OFF DATA ON DRAINAGE CANALS.

The gauging stations for the determination of run-off have been continued on Toisnot Swamp Canal, Wilson County, and on Third Creek Canal, Iredell County. The records of daily gauge heights on Third Creek are complete from March 17, 1913, to date; those on Toisnot Swamp from March 29, 1914, to date. A paid observer is employed at each place.

Current meter readings of the flow in the canal at the station on Third Creek have been obtained from time to time, at different stages of the water by Mr. J. P. O'Quinn, gauge observer. Thus an estimate of the amount of water carried by the canal for the different gauge heights may be obtained. A run-off curve for various stages up to ten feet has been plotted.

#### *Preliminary Examinations and Reconnaissance.*

Three examinations of a preliminary or reconnaissance nature have been made and reports issued covering a total area of 18,500 acres. A reconnaissance survey was made of the land in the vicinity of Big and Little Alligator Swamps in northwestern Brunswick County.

#### *Study of Efficiency of Underdrains on Cotton Valley Farm.*

Arrangements were made with George A. Holderness, owner of the Cotton Valley Farm, near Tarboro, Edgecombe County, to conduct experiments on the tile drainage systems installed under the supervision of this division. Two systems, each with a separate outlet, were selected. One system, draining about sixteen acres, has tile drains uniformly spaced 100 feet apart at an average depth of 3 feet in a black sandy loam soil underlaid mostly by sand. The other system draining about forty-six acres has tile drains uniformly spaced 60 feet apart over most of the area, at an average depth of 3 feet in a stiff clay soil.

Two concrete weir boxes, one at the outlet to each system, have been built, and the discharge or run-off from the underdrained areas is

measured by 90-degree triangular weirs. Continuous records of the heads on the weirs are obtained by automatic register clocks which need attention but once a week to change charts and to rewind clocks. Daily rainfall records are obtained by a rain gauge located in the center of the two drainage areas, which adjoin on opposite sides of the outlet canal. From the measured discharge from the two drainage systems, it is hoped to obtain some valuable data as to the amount of run-off to be provided for in the design of underdrainage systems in two types of soil. By keeping continuous records of both the rainfall and the run-off, it is expected that some relation may be obtained between the two.

In order to study the action of tile drains in lowering the ground water level, about 120 observation wells,  $3\frac{1}{2}$  feet deep have been installed between the tile lines. Measurements of the water level in these wells are made two or three times a week and oftener in wet seasons.

Mr. W. J. Wickham, who helped to install the drains on Cotton Valley Farm, has been employed since November, 1916, to look after these records. It is hoped to continue the observations for another year at least.

### *Experimental Maintenance Work on Drainage Canals.*

Under ordinary circumstances, a new canal, if properly constructed, should require little attention or repair for two or three years, but after that, it should be given annual attention. The removal of weeds, silt, logs, trees and other obstructions from the canal annually, then becomes a necessity to keep it up to its original efficiency. The opening up of new land in the district necessitating the construction of farm ditches emptying into the main canal, requires that some attention be given these outlets, so that they will not cave or permit the carrying of loose or eroded dirt into the main waterway, causing sand or silt bars to form. In many of the districts in the Coastal Plain section, the flow during a large part of the year is small and the water tends to follow a winding course over the wide bottom of the canal. It seems advisable to confine this water to a straight, narrow, low-water channel, leaving the larger cross-section of the ditch to take care of the flood water.

In the Piedmont or hilly section of the State, the deposition of sand in the main canal brought down by its swift flowing tributaries becomes a serious menace. The breaking down of banks at weak and low places, and on the outside of curves, at flood stages, causing the water to rush over cultivated fields, thus ruining the land either by too much water or the deposition of sand, needs attention also.

For the purpose of studying the best methods and cost of maintenance of drainage canals in this State, the Office of Drainage Investigations, U. S. Department of Agriculture, S. H. McCrary, Chief, expended approximately \$1,200 in the spring of 1917. This work was done under the direction of the writer, assisted by Mr. Guy L. Smith, junior drain-

age engineer, who had immediate charge of the field work. The districts selected for these experiments were Back and Jacob Swamps, Robeson County, in the Coastal Plain, and Third and Fourth Creeks, Iredell County, in the Piedmont Section.

The work on Back and Jacob Swamps was carried on during the months of March, April, and May, and that on Third and Fourth Creeks in June, continuing into July. The object of the work was to put selected stretches of these canals in good order and to keep them in this order with a minimum expenditure annually. It is the intention to carry on this maintenance work each year.

On Jacob Swamp, a section approximately 2 miles long, and on Back Swamp, a section  $1\frac{3}{4}$  miles long, were selected. Before the work was started, a survey was made and cross-sections of the canal prism taken every 100 feet, all referenced to a base line along the side of the canal which may be easily picked up each year. The work on Jacob Swamp consisted in clearing the banks, the removal of all weeds, sand bars, logs, trees and other obstructions from the canals, and the excavation of a low-water channel and the construction of outlet works to all side ditches. The work on Back Swamp was not so extensive, since no weeds were growing in the bottom of the canal and very little brush on the banks. It consisted in the removal of sand bars, logs, trees and other obstructions and the construction of outlet works to side ditches. Several types of outlets were constructed, the idea being to devise cheap but efficient methods of letting water into the canal, using as much local material that every farmer has access to as possible. A complete record of all the details affecting the work and cost were kept. From 10 to 12 men on an 8-hour basis, were employed on Back and Jacob Swamps. Approximately \$650 were expended for labor and material on Jacob Swamp and \$200 on Back Swamp.

The work on Third Creek, Iredell County, consisted principally in repairing breaks at low and weak places in the banks by the construction of wooden retaining walls along a stretch of about 2 miles at the upper end of the district. The work on Fourth Creek consisted in repairing a particularly bad opening in the bank about 500 feet long, located on the land of Mr. F. H. Daniels. Approximately \$240 were expended for labor and material on Third Creek and \$140 on Fourth Creek. By watching the action of these walls under the most severe conditions, it is hoped to devise some cheap and permanent methods of maintenance.

Respectfully submitted,

H. M. LYNDE,  
*Senior Drainage Engineer.*



# STUDIES ON RESISTANCE OF TOMATOES TO BACTERIAL WILT.

By E. E. STANFORD.

Studies have been conducted at this Station for several years upon wilt diseases of tobacco and tomatoes, both of which are caused by a bacterial organism, *Bacterium solanacearum* E. E. S. Since this organism is very generally the cause of a tomato wilt disease within North Carolina, reports of its presence in thirty-nine counties having been received, an attempt was made to learn if certain commercial varieties of tomatoes possessed any marked resistance or natural immunity to wilt. While only negative results have been secured and there appears to be no hope of successfully combating this disease by seeking for natural resistance and immunity, the results are recorded in the belief that they are of value to others who may undertake experimentation upon the same disease.

During the season of 1914, seven varieties of tomatoes were grown in a field near Creedmoor, N. C. A part of this field was being used in studies on the effect of rotation and of the employment of certain cropping systems upon the control of tobacco wilt. The soil was believed to be thoroughly infested with the wilt organism, as judged by the prevalence of wilt in previous crops. The following tabulation presents the results of this season's results on wilt resistance.

TABLE 1. TOMATO WILT RESISTANCE TESTS AT CREEDMOOR, N. C., IN 1914

| VARIETY                    | No. of Plants | CONDITION |        |
|----------------------------|---------------|-----------|--------|
|                            |               | Healthy   | Wilted |
| Louisiana Wilt Resistant** | 26            | 10        | 16     |
| Texas Belle                | 26            | 1         | 25     |
| Stone                      | 28            | 1         | 27     |
| Golden Queen               | 23            | 8         | 15     |
| Lorillard                  | 25            | 14        | 11     |
| Bonny Best                 | 25            | 1         | 24     |
| Livingston's Globe         | 45            | 3         | 42     |

It is evident, first of all, that the number of plants used in this test was too small to serve as a convincing demonstration. It will be noted, however, that a smaller proportion of the variety, Lorillard, succumbed to wilt than of the other varieties. On the assumption, therefore, that this indicated a degree of resistance, seed were saved from the choicest fruits of the plants which remained healthy. These, together with seed from a number of other varieties, were used for a more extensive test

\*Mr. E. E. Stanford was connected with these investigations until his resignation from the Station, March, 1917. This report was prepared with Mr. Stanford's permission, by Frederick A. Wolf, Botanist, North Carolina Agricultural Experiment Station.

\*\*This variety is resistant, in Louisiana, to wilt produced by *Fusarium* sp.



during the following season. The field used in this test was located at West Raleigh. Tomatoes had been grown in this field during 1914, and serious losses from bacterial wilt had occurred so that the soil was very generally infested.

The results of examination of these plants on two successive dates are brought together in Table 2.

TABLE 2. TOMATO WILT RESISTANCE TESTS AT WEST RALEIGH

| VARIETY                     | No. of Plants | CONDITION AUG. 25 |        | CONDITION SEPT. 14, '15 |        |
|-----------------------------|---------------|-------------------|--------|-------------------------|--------|
|                             |               | Healthy           | Wilted | Healthy                 | Wilted |
| Louisiana Wilt Resistant.   | 71            | 48                | 23     | 19                      | 52     |
| Oregon Wilt Resistant.      | 81            | 44                | 37     |                         |        |
| Greater Baltimore No. 456   | 83            | 51                | 32     |                         |        |
| Stone No. 457.              | 76            | 53                | 23     | 24                      | 52     |
| Duke of York.               | 101           | 34                | 67     |                         |        |
| Blight Proof.               | 70            | 35                | 35     |                         |        |
| Lorillard . . . . .         | 72            | 53                | 24     | 28                      | 49     |
| Long Keeper . . . . .       | 95            | 29                | 66     |                         |        |
| Redfield . . . . .          | 70            | 41                | 29     |                         |        |
| Stone . . . . .             | 87            | 65                | 22     | 43                      | 44     |
| Stone No. 460.              | 95            | 75                | 20     |                         |        |
| Greater Baltimore . . . . . | 93            | 79                | 14     | 56                      | 37     |
| Stone No. 459.              | 91            | 83                | 8      |                         |        |
| Prosperity . . . . .        | 81            | 73                | 8      |                         |        |
| My Maryland . . . . .       | 88            | 69                | 19     |                         |        |
| Greater Baltimore . . . . . | 96            | 85                | 11     | 23                      | 73     |
| New Experimental . . . . .  | 85            | 65                | 20     |                         |        |
| John Baer . . . . .         | 90            | 72                | 18     |                         |        |
| Bonnie Best . . . . .       | 71            | 44                | 27     |                         |        |

It was found during this season, that many of the varieties tested, disregarding wilt resistance, were not suited because of size, texture, color, flavor, or yield to North Carolina conditions. Others made very poor vegetative growth. Consequently, seed from these varieties were not saved for subsequent tests. It was believed to be desirable, however, to study further three varieties, namely: Greater Baltimore, from three sources, Lorillard, and Stone. Seed were, therefore, saved from plants which remained healthy. These were tested together with a number of varieties not previously used, in 1916, at West Raleigh.

With reference to this season's tests, it may be said that the three varieties whose seed were saved from the 1915 crop showed no increased resistance nor did the varieties not previously tested appear to possess any resistance.

In conclusion, it does not appear that resistance, in tomatoes, to bacterial wilt can be augmented by seed selection from plants which remain healthy to maturity.

